INCIDENCE AND FACTORS INFLUENCING POST MASTECTOMY LYMPHEDEMA

Dissertation submitted to the Tamil Nadu Dr. M.G.R. Medical University,

Chennai,

in partial fulfillment of the requirement for the award of

Master of Chirurgiae (M.Ch.) Branch III Degree

(PLASTIC SURGERY)

BY

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DEPARTMENT OF PLASTIC SURGERY

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August 2011 - 2014

CERTIFICATE

This is to certify that this dissertation entitled "**THE INCIDENCE AND FACTORS INFLUENCING POST MASTECTOMY LYMPHEDEMA**"is the bonafide research work done by **Dr. SOUMYA GUPTA**, Christian Medical College, Vellore, in partial fulfillment of the requirement for the award of Master of Chirurgiae (M.Ch.) in Plastic and Reconstructive Surgery under my guidance and supervision during the academic year 2011-2014.

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Sub: **FLUID Research grant project NEW PROPOSAL :(PERMISSION ONLY)**
To study the incidence and factors influencing post mastectomy lymphedema.
Dr. Soumya Gupta, Senior Registrar, Plastic Surgery, Dr. Ashish Kumar Gupta, Plastic Surgery, Dr. MJ Paul, General Surgery.

Ref: IRB Min. No. 7732 dated 04.01.2012

Dear Dr. Gupta,

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project entitled "To study the incidence and factors influencing post mastectomy lymphedema" on January 4, 2012. I am quoting below the minutes of the meeting.

The Committees reviewed the following documents:

1. Format for application to IRB submission
2. Consent Form (English, Telugu, Hindi and Tamil)
3. Cvs of Drs. MJ Paul, Ashish Kumar Gupta.
4. A CD containing documents 1 – 3

The following Institutional Review Board (Ethics Committee) members were present at the meeting held on January 4, 2012 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore- 632002.

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We approve the project to be conducted as presented.

The Institutional Review Board expects to be informed about the progress of the project, any serious adverse events occurring in the course of the project, any changes in the protocol and the patient information/informed consent and requires a copy of the final report.

Yours sincerely,

G. Kang

Gagandeep Kang, MD, PhD, FRCPath
Secretary (Ethics Committee)
Institutional Review Board

Secretary
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CONTENTS

Introduction

Arm lymphedema is a complication following surgery for breast cancer. It varies from mild swelling to an incapacitating condition which is associated with numerous risk factors. This study is on the incidence of lymphedema among patients after breast cancer surgery in our institute. The worldwide incidence of lymphedema varies from 10-60 % [(1)]. This wide range is due to difficulty in measurement methods, differential opinion on diagnostic criteria, and duration of follow up as well as varying study sample size.

In breast cancer patients, lymphedema has been described as an often overlooked, under diagnosed and undertreated condition, and the same can likely be said for patients with other malignancies. It has a major communal effect on physical condition, quality of life, functional status, family and finances.

Many risk factors have been attributed to susceptibility of patients for developing this condition. These are individual, disease and management related factors. Obesity, hypertension, nodal involvement, axillary dissection, wound infection, chemotherapy and radiotherapy are most common ones.[(3,4,5,6,7,8).]

The measurement of lymphedema can be done by many ways. The objective assessment methods like girth measurement, volume displacement and perometer are utilized in incidence and risk factor study commonly [(15)]. Investigations like lymphoscintigrapy, MRI are more expensive. The symptoms of lymphedema have been known to develop as early as one week to as late as several years after surgery. The reason for varied presentation among patients is largely unknown. Most of the patients develop this condition within 3 years after surgery.

It is difficult to predict which patient will end up with this added morbidity. Identification of risk factors will enable the health care providers to check lymphedema at an

early stage. This study aimed to identify the risk factors to facilitate early detection and identification of high risk cases. How each risk factor causes edema, is an unsolved mystery. There are no straightforward predictive factors to categorise patients and implement measures. To further compound to our problem, the literature gives contrasting data on the risk factors associated with lymphedema. Limited work has been done in Indian subcontinent and not much data is available on Indian patients. It is difficult to compare western patient to an Indian one as the lifestyle and practices are different.

The most important factor in treating lymphedema is patient compliance. The patient can be trained in self care programme to minimise the risk. Also, early referral to lymphedema therapists for intervention has been shown to reduce the risk of chronic lymphedema and to improve outcomes. The preventive measures like layered bandaging; massages can be started early to prevent arm swelling in high risk cases. Preoperative patient education, avoidance of intravenous puncture on the affected site and limb care are helpful and effective preventive measures.

The goal of this study is to assess the incidence and risk factors of lymphedema in Indian women. This would add to the scarce literature available on Indian patients with breast cancer. We intend to improve the standard of care and create awareness among people about post mastectomy lymphedema.

Review of Literature

REVIEW OF LITERATURE

Lymphedema occurs due to accumulation of protein rich fluid in the interstitial tissue. The stagnant lymph causes interstitial inflammation leading to further obstruction of flow and thickening of tissues and skin. Lymphedema occurring due to congenital absence of lymphatics is known as Primary Lymphedema. Secondary lymphedema happens following filarial infections or cancer ablations due to obstruction in lymphatic drainage. Lymphedema after breast cancer is the most common cause worldwide although many other cancers are associated with the same. The management and long term care plan of both the types is same. This condition gravely affects the quality of life. If controlled in initial period, it can improve the outcome. This requires great care, commitment and compliance from the patient. The pathophysiology of lymphedema is not well understood but most studied in patients with lymphedema following mastectomy.

Anatomy of upper limb lymphatic system.

The lymphatic system comprises of

1. Superficial dermal or primary lymphatics and
2. Secondary lymphatics in subdermal plane.

The secondary lymphatics are larger and drain the primary lymphatics. These run parallel to the superficial veins and drain into lymphatic vessels located in the subcutaneous fat adjacent to the fascia. Unidirectional lymphatic flow in secondary and subcutaneous lymphatic vessels is aided by muscular wall and valves which are lacking in primary lymphatic vessels.

There also exists an intramuscular system of lymphatic vessels that parallels the deep arteries and drains the muscular compartment, joints, and synovium. The superficial and deep lymphatic systems probably function independently, except in abnormal states, although there is evidence that they communicate near lymph nodes. The lymphatic vessels of the arm drain into ipsilateral subclavian lymphatic trunk and then into subclavian vein.

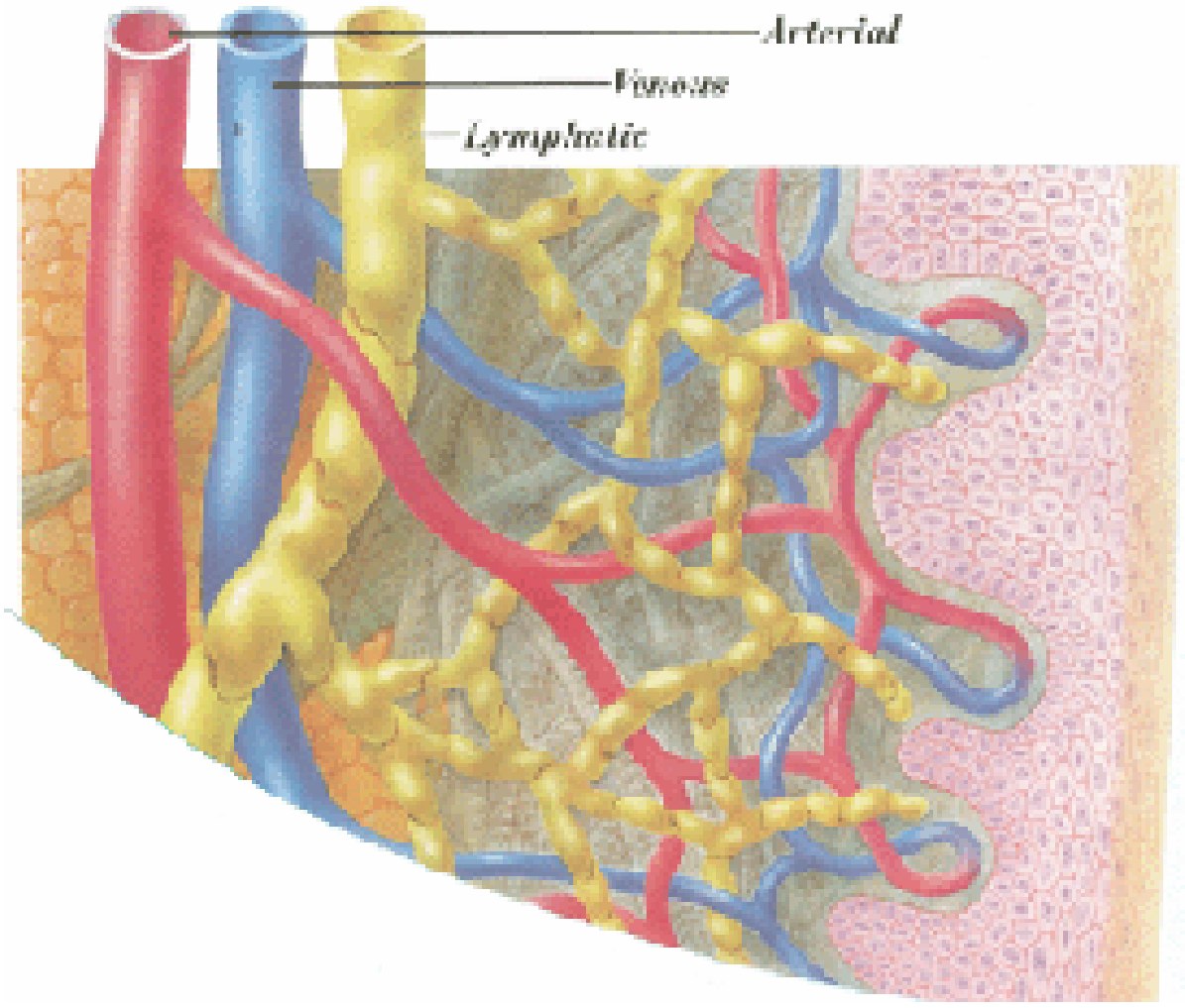


Figure 1: Relationship of deep artery, vein and lymphatic channels.

The upper limb has a rich lymphatic supply especially the hand. In a digit a pair of vessel runs along either side traversing the dorsal surface. They communicate with the palmar plexus in the wrist proximally and with the wrist vessels at the medial aspect of the wrist.

On either surface of the wrist the vessels form the following pattern:

a) Radial vessels accompanying the cephalic vein,

b) Median lymph vessel which accompanies median antebrachial vein,

c) Ulnar lymph vessel accompanying the basilic vein.

The ulnar vessels terminate in the supratrochlear lymph nodes and the lateral nodes of the axilla. The radial vessels drain into the deltopectoral lymph nodes.

The deep lymphatic vessels of the upper limb accompany the deep arteries (Figure 1). They communicate extensively with the superficial vessels. It is drained by the lateral group of lymph nodes of the axilla and to the glands along axillary artery.

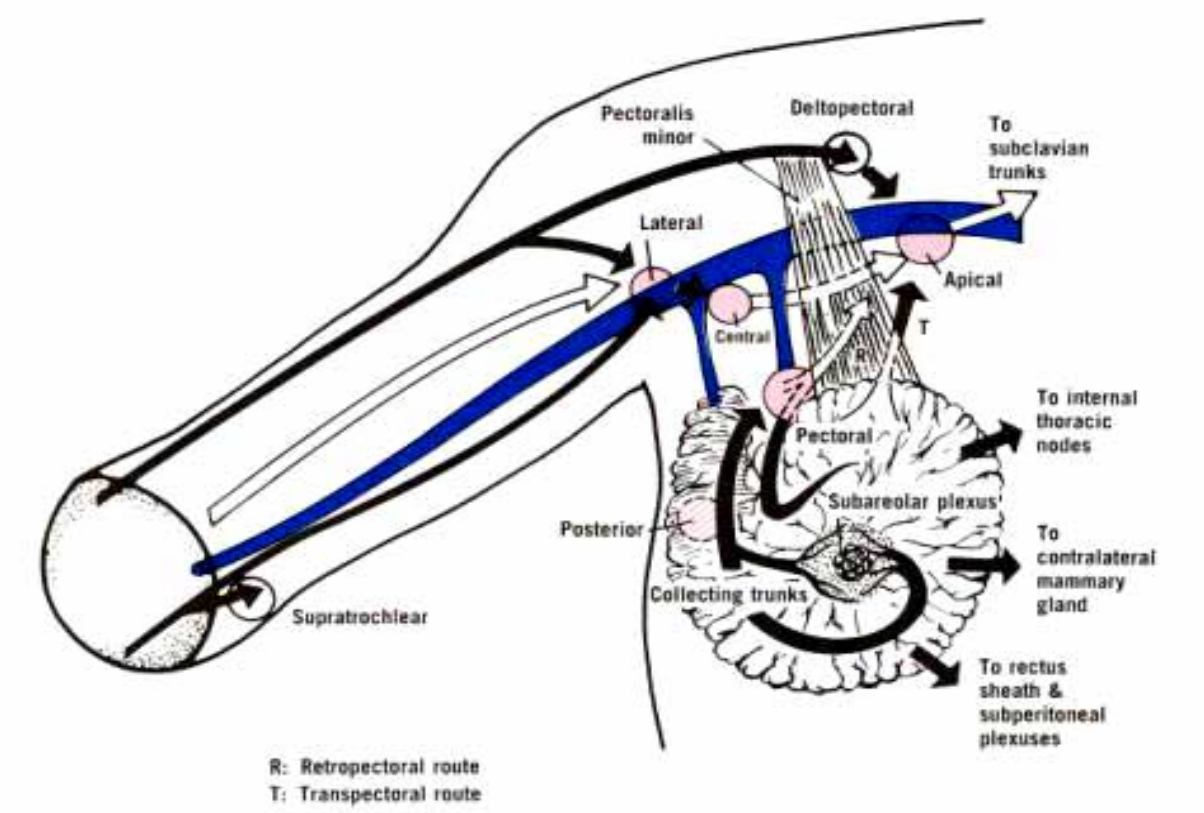


Figure 2: Lymphatic drainage of upper limb

Axillary Lymph Nodes.

These important nodes are divided into five groups.

1. The lateral nodes lie behind the axillary vein and drain the upper limb.

2. The pectoral nodes, at the inferior border of the pectoralis minor, drain most of the breast.

3. The posterior, or subscapular, nodes, in the posterior axillary fold, drain the posterior shoulder.

4. The central nodes, near the base of the axilla, receive the lymph from the preceding three groups. They form the group most likely to be palpable (against the lateral thoracic wall).

5. The apical nodes lie medial to the axillary vein and superior to the pectoralis minor. They drain all other groups and sometimes the breast directly. The apical group of nodes also

empty into two or three subclavian trunks, which enter the jugular-subclavian venous confluence, or join a common lymphatic duct, or empty into lower, deep cervical nodes.

Pathophysiology

The lymphatic system maintains the fluid homoeostatic mechanism. Tissue edema results due to imbalance between fluid generation and the transport capacity of the lymphatic channels. This can result due to congenital malformation of lymphatics as in primary lymphedema or due to destruction of the lymph nodes / lymphatics in secondary lymphedema[16].

During mastectomy with axillary dissection the lymphatic channels are disrupted due to dissection. The tissue inflammation causes fibrosis amounting to obstruction of lymph flow. This insult is further exacerbated by radiotherapy, which increases tissue scarring.

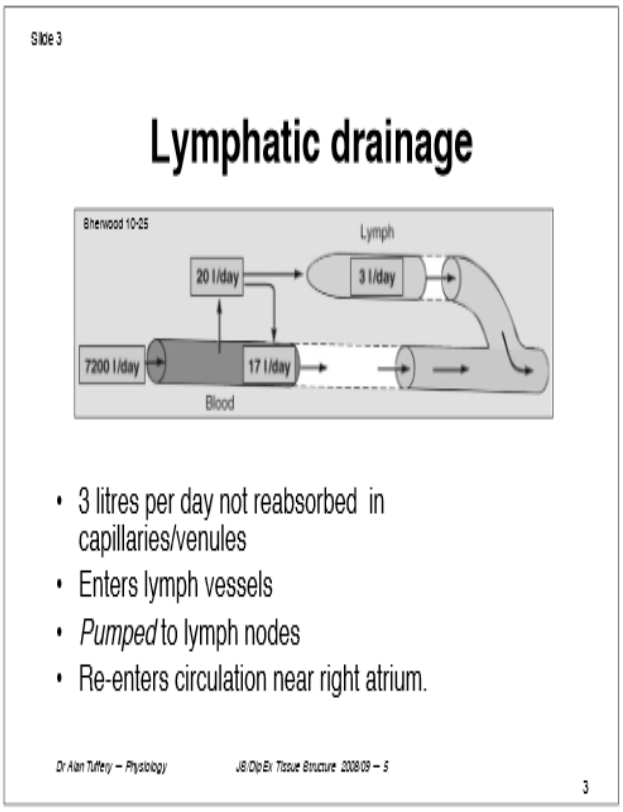
The physiology of lymphedema obeys the '**Starling law**' (Fig 3). Lymphatics carry 10 % of the interstitial fluid and the rest is carried by the venous system. The average blood capillary pressure equals the colloid oncotic pressure. In the arterial circulation the capillary pressure is more than oncotic pressure. This causes ultra filtration leading to increased interstitial fluid transfer. On the venous side there occurs re-absorption as the oncotic pressure is greater than capillary pressure. The interstitial oncotic pressure and plasma oncotic pressure also play an important role to complete the circulation dynamics and maintain homoestasis[17].

The stasis of lymph facilitates interstitial accumulation of protein and cellular metabolites. This raises the tissue colloid osmotic pressure causing water accrual and elevated interstitial hydraulic pressure. There is associated increase in fibroblasts, adipocytes and keratinocytes in the interstitium. These cells are recruited due to presence of cellular

metabolites and decreased clearance of lymph. The mononuclear cells initiate chronic inflammatory response leading to collagen deposition, overgrowth of connective and adipose tissue [18].

Breast cancer related lymphedema

Apart from the lymphatic obstruction and destruction there are other factors responsible for limb edema as the experiments prove that more tissue damage is required than recent surgery. The two probable factors were protein content and vascular factors. It was demonstrated by wick technique that protein content of the interstitium of the affected limb was lower compared to the normal side. This was probably due to steady state reached by the fluid homoeostasis. The vascular mechanism proposed attributing to lymphedema was increased angiogenesis leading to raised filtration load[19].



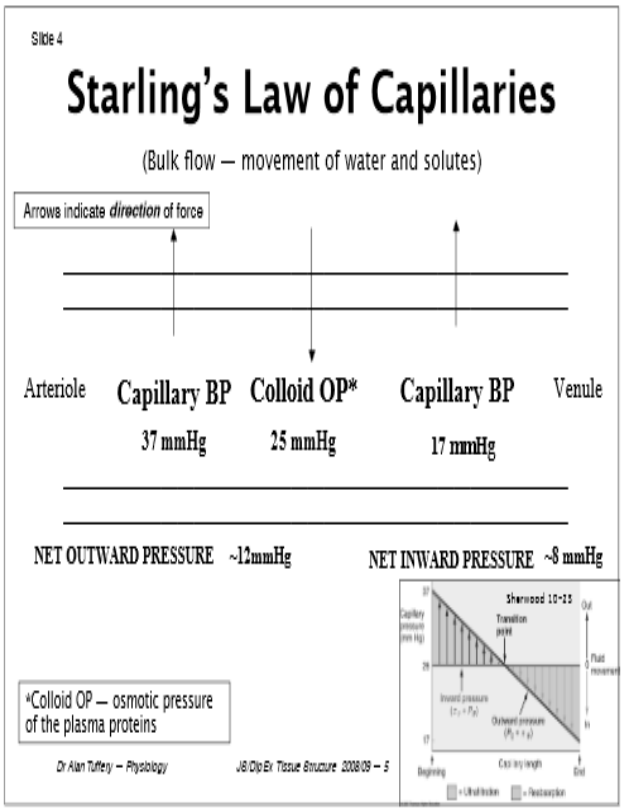


Fig 3: Diagram depicting starlings law

Clinical features

It is difficult to predict susceptibility to develop lymphedema after axillary block dissection. It starts with apparently normal limb and gradually progresses in severity. Few patients develop lymphedema within weeks of surgery where as some take years [(20)]. This latent phase may represent a period of balance between existing increase lymph load and reduced outflow capacity [(21)].

The swelling can affect either a part or the limb completely. Initially the swelling is soft with pitting and gradually progresses to indurated, non pitting type with secondary skin changes. The precipitating factor is commonly infection but it is incompletely understood. The protein rich lymph attracts bacterial growth. This compounded by poor immunity worsens the edema causing cellulitis, lymphangitis and further fibrosis involving lymphatics. The soft tissue infection can vary from subtle swelling to necrotising infection with systemic toxicity.

The infrequently seen but known complication of long standing lymphedema is Stewart - Treves syndrome that is malignant angiosarcoma, lymphoma, melanoma, squamous cell carcinoma and Kaposi sarcoma [(22)].

The subclinical lymphedema begins with complains of heaviness/ tightness in the arm. This progresses to tightness of the regular outfit. The final stage is hyperkeratotic, verrucous skin with non pitting edema of the arm. Recurrent episodes of infection worsen the condition. Shanton et. al., in 2009 claimed that lymph flow is raised in both the subcutis and muscle of both arms in postsurgical breast patients who later developed breast cancer-related lymphedema. They also found that there was delayed lymphatic pump failure [(21)].

Stages of Lymphedema

The International Society for Lymphology classified lymphedema as [23]:

Stage 0: Subclinical lymphedema: the swelling is not visible in spite of impaired transport. It may exist months or years before evident swelling.

Stage I: Spontaneously reversible: Accumulation of protein rich lymph. There may be Pitting edema which reduces on limb elevation.

Stage II: Spontaneously irreversible: Pitting mayor may not occur. There is tissue fibrosis hence limb elevation does not reduce the swelling

Stage III: Lymphostatic elephantiasis: pitting is absent with secondary skin changes like acanthosis, fat deposits and warty overgrowths.

Within each stage, a functional severity assessment was also utilized based on volume difference assessed as minimal (<20% increase) in limb volume, moderate (20-40% increase), severe (>40 % increase).

Lymphedema assessment

There are various methods of diagnosis of lymphedema. The disease is mostly diagnosed clinically. The stages of lymphedema are easily determined clinical examination. It is the subclinical stage which requires investigations and in cases where cause is uncertain. The following table is an easy way to enumerate the variety of investigations available to determine and quantify lymphedema.

Table 1

Type of assessment	**Measure**
Qualitative	Lymphangiography
	CT scan
	MRI
	Ultrasound
	Lymphoscintigraphy
	Fluorescence lymphography
	Computed Tomographic Lymphography
Quantitative	Circumferential measurement
	Volumetry
	Tonometry
	Quantitative lymphoscintigraphy
	Electric volumetry (perometer)
	Bioimpedance spectroscopy

The qualitative tests are done when the diagnosis or cause is uncertain. These can be done to detect additional coexisting condition in the lymphedematous limb like lymphovenous malformation.

Lymphangiography helps in evaluation of lymphatic channels condition in candidates planned for lymphatic microsurgery. Here the dermal lymphatic vessels are surgically cannulated after intradermal injection of dye. Less invasive techniques like CT and MRI can also be used to measure lymphedema and to characterize the tissue involvement especially in malignancy. Lymphoscintigraphy is the gold standard investigation. Its limitation is high cost and unavailability in many centres. A radiolabelled tracer is injected in subdermal interdigital space of the affected limb. The transport of contrast is monitored with gamma camera to visualise the course of lymphatic trunks. Typical abnormalities in lymphedema found are absent or delayed transport of tracer, absent or delayed lymph node visualization, crossover filling with retrograde backflow and dermal backflow [(24)].

The quantitative method helps in objective assessment and categorization of the condition. The most common and easy method is by measuring arm circumference at fixed levels [(25)]. The limb edema can be calculated using truncated cone geometric calculation. Another method is calculation using volume displacement. The amount of water displaced by the submerged limb gives the volume of edema fluid. Generally, displacement of more than 200 ml is designated as lymphedema [(26)].

Tissue tonometer measures the pressure required to press the skin. This assesses the compressibility of tissues and indirectly lymphedema [(27)]. Perometer utilizes infrared rays to measure tissue volume. It is more portable and accurate than water displacement method but not as cost effective [(28)].

Multi-frequency bio impedance analyser is the recent instrument to detect and quantify early lymphedema. A low ampere current (200-800mAmp) is passed through the body. The resistance offered by the tissues which measures the impedance. The pathological accumulation of extracellular fluid is detected by decrease in the measured impedance, in ratio to the amount of extracellular fluid accumulation [29].

Incidence and Risk Factors

The incidence of lymphedema has a wide range. It varies from 10-60 %. In 1998, Petrek et. al., mentioned the incidence as 6-30 % [30]. In a retrospective study at Taiwan, Liao et. al., reported the incidence as 8.1% with arm circumference difference more than 2cm in 570 patients. The incidence of self reported lymphedema was 28% [31]. The risk factors of lymphedema in their study were identified as radiotherapy and modified radical mastectomy.

In an audit done by Querci et. al., in 2003, women with axillary level 1and 2 dissections were observed to have overall incidence of 32.8%. They had divided the limb swelling based on region and found differential edema prevalence rate. The risk factors attributed were operating surgeon, positive node status for cancer, right side limb and dominant limb [32].

In 2009 Sagen et. al; concluded that physical activity does not cause lymphedema. They encouraged patients to start early activity [33].

A study in India, Deo et. al., in 2004 in their study of 300 patients concluded the prevalence rate of 33.5%. Stage of disease, body surface area, loco regional radiotherapy, presence of co- morbid conditions and anthracycline based chemotherapy had emerged as significant risk factors in univariate analysis whereas axillary radiation and presence of co-morbid conditions were significant risk factors for lymphedema development in multivariate analysis [34]. Pillai et. al., found the incidence rate as 41%. They found correlation between increased lymphedema rate and advanced stage of disease, presence of co-morbid conditions, and postoperative loco-regional radiotherapy. Axillary irradiation and pathological nodal status emerged as significant risk factors for lymphedema [35].

In a population based study from Australia, Hynes et. al., reported a overall incidence rate of 33% in a 6 to 18 month follow up. The factors associated with increased odds of lymphedema were older age, extensive axillary dissection and treatment related complications. Patient factors like lower socioeconomic status, having a partner, greater child care responsibilities, being treated on the dominant side and participation in regular activity were associated with decreased odds ratio [(36)].

Clark et. al., found the incidence rate as 20.7% at three year follow up. The statistically significant risk factors were skin puncture during hospital stay, BMI more than 26 and mastectomy [(37)].

In large study by Park et. al., in Korea, involving 450 women, the incidence of lymphedema was 24.9%. The risk factors responsible were late disease stage, radical axillary dissection, radiotherapy and BMI more than 25 [(38)].

A large study done by Norman [(20)] et. al., in 2008 involving more than 600 breast cancer patients the cumulative five year incidence was found to be 42%. They have also calculated incidence based on severity of lymphedema and time from surgery. The cumulative incidence at two and three years was more than 80 %. In 2010 the author [(2)], studied multiple factors attributed to Breast cancer related lymphedema. According to their multivariate analysis, axillary lymph node dissection and anthracycline based multi-agent chemotherapy regimens were significantly associated with lymphedema risk. No significant risk was found with radiation therapy to chest or axilla, hormonal therapy and type of breast surgery. They also did not find any correlation with number of positive nodes.

In a review by Erickson et. al., in 2001 the estimated incidence was 26%. One in four women was suspected to develop lymphedema after breast cancer treatment [(39)]. A meta-analysis by DiSipio et. al., (40) in 2013 studied their overall incidence rate and it was

calculated as 21.4%. The risk factors associated with high level of evidence were axillary lymph node dissection, greater number of lymph node removal and obesity.

Thus, incidence varies depending on the criteria included by the researchers and method of determination. The inclusion criteria of many studies vary as some are based on telephone conversation where as some have determined by limb circumference using water displacement, perometer or girth measurement at different levels. The cut off values to distinguish lymphedema also varied author to author.

It was interesting to note that some studies mention the point prevalence of lymphedema. Some patients develop transient swelling in early stage. Devoogdt in 2011 stated the incidence of breast cancer related lymphedema was around 67-80% in the first year after axillary node dissection [(6)].

Age and risk of lymphedema

Armer et. al., found that incidence of post mastectomy lymphedema among younger patients was high. The incidence was 41% in patients less than 60 years and 30.6% among more than 60 years age group [(41)].

Coriddi claimed that women more than 50 years had higher risk of lymphedema [(47)]. Norman et. al., [(2)] also found a statistically significant association with lymphedema and younger age group. Parbhoo stated that young women are more susceptible as they present with aggressive locoregional primary and recurrence. They also have an active lifestyle subjecting them to more chances of trauma and infection [(42)].

However, according to Helyer et. al., age was not a predictive factor for development of lymphedema [(43)]. Herd-Smith et. al., [(7)] also did not find any correlation between age and risk of lymphedema.

Socioeconomic status as the factor

Lower level of education and income had a significant positive association with lymphedema according to Norman et. al., in 2010 [2]. Hayes et. al., [37] found that lower socioeconomic status was associated with decreased odds ratio of lymphedema. Kwan et. al., attribute education as a risk factor for breast cancer related lymphedema [45].

Side of the disease

There was no correlation found between risk of lymphedema and dominant side of the patient [13]. Herd – Smith claimed increased incidence on left side compared to right side [7]. Querci et. al., found increased risk on the right side and dominant side [32]. They also suggested that volume of dominant arm is 3-9% greater than non dominant arm. Even Mak et. al.,, in a study in honk Kong found increased risk on the dominant side due to chances of trauma [44]. In same study by Hayes et. al., [37] said that dominant side was associated with decreased odds ratio of developing lymphedema.

Body mass index (BMI)

Obesity and BMI more than 25 is associated with high risk of developing post mastectomy lymphedema. [1,2,3,8,10,38,44,45]. In the Indian study in AIIMS by Deo et. al., [34] expresses increase in body surface area as risk factor. However, Pillai [35] et. al., do not mention regarding weight and BMI in their study. An exclusive study done by Helyer et. al., [43] on obesity, insisted that obesity is associated with high odds ratio of developing lymphedema.

Herd - Smith [7] found poor correlation with body mass index and lymphedema.

A study done in china by Huang in 2013 listed risk factors as obesity, age and radiotherapy [46]. Coriddi et. al., [47] although studies obesity as the risk factor for lymphedema but concludes that it did not contribute to the increased severity of the condition. Ridner in a longitudinal study determined that obesity is a risk factor for lymphedema but post operative weight gain is not [48].

In a univariate analysis by Swenson et. al., in 2009 implied that overweight patient were more prone to have axillary radiation, mastectomy, chemotherapy, more positive nodes, fluid aspirations after surgery, and active cancer status [49].

Weight reduction helps in reducing the risk of lymphedema [50]. In a randomised controlled trial by Shaw et. al.,, they demonstrated weight reduction with low energy intake in diet itself lowered risk of lymphedema [51].

Obesity also predisposes the patient to other comorbidities like hypertension, increased chances of infection. They are also susceptible to recurrence and poor prognosis. Obesity is also a risk factor for many other forms of cancer like colon, prostrate. Mechanism amounting to reduced prognosis among obese are adipose tissue-induced increased concentrations of estrogens and testosterone, insulin, bioavailable insulin-like growth factors, leptin, and cytokines. Additional proposed mechanisms include reduced immune functioning,

chemotherapy dosing, and differences in diet and physical activity in obese and nonobese patient [52].

Shon et. al., reported 5 cases of angiosarcoma in patients with post mastectomy lymphedema in morbidly obese patients [53].

Weight gain after surgery is another indicator of lymphedema according to many studies [5, 70].

Pre-operative upper limb morbidity

Morbidity in the form of previous injury, arthritis or infection of the upper limb of the side affected by breast carcinoma is a predisposing factor for lymphedema. It has been postulated and in some cases proven by studies that patients with prior upper limb morbidity of the affected side are at a higher risk of developing arm swelling after surgery [2,3,54]. Mak et. al., [44] demonstrated increased odds ratio of developing moderate to severe edema in patients with previous inflammation- infection of the ipsilateral upper limb.

The mechanism is that these patients have disrupted lymphatics due to prior injury. Women with arthritis manifest lymphedema as they exercise less due to pain. Sagen et. al., in their randomised controlled trial proved that post operative exercise does not predisposes to lymphedema, rather it may be beneficial to the patient and improve outcome [33].

Springer et. al., in another study studied that preoperative and early physiotherapy with shoulder movement assessment with follow up helped in early diagnosis of lymphedema [55].

Hypertension and comorbid conditions

Comorbidities especially hypertension has a strong penchant for lymphedema. The increased hydrostatic pressure causes filtration of fluid and reduced capillary absorption further causes accumulation of fluid in intersitium. Comorbid condition was found to be predisposing factor for lymphedema according to Deo et. al., [34]. However Pillai et. al., do not mention this factor in their study [35]. Norman [2], Armer [3] have included comorbid condition in their risk factor evaluation but did not relate it as the risk factor for lymphedema as per analysis. Rockson [13] in his review article considers hypertension as a pertinent risk factor secondary to axillary surgery and high dose radiation therapy.

Ridner et. al., in a community based study comprising 64 women concluded that breast cancer patients were older with pre-existing comorbid conditions, taking medications causing fluid retention. This may be a risk factor for lymphedema after breast cancer [56].

Meeske et. al., in a study comparing black and white women affected with breast cancer related lymphedema showed that hypertension was a risk factor for lymphedema in spite of racial difference [57].

Soran et. al., [58] had included multiple conditions like hypertension, hypothyroidism etc as risk factor but no significant correlation was found.

Extent of surgery and lymphedema

The radical surgery is associated with lymphedema incidence. It involves the extent of lymphnode dissection and even surgeon factor. The radical surgery is known to disturb the lymphatic drainage pathway. The number of nodes removed at the time of surgery has a positive correlation with development of lymphedema. The number of nodes involved by the disease, however, has mixed results according to various authors.

According to Schunemann et. al., the prevalence of lymphedema after radical, modified radical and breast conservation surgery was 39 %, 24 % and 9% respectively [(59)]. Deo et. al., did not find any statistical significance between extent of surgery, axillary clearance and lymphedema [(34)]. Most of the patient presentation was with advances stages requiring axillary clearance. They claim that post operative radiation to the axilla was responsible for the development of lymphedema rather than level of clearance. Pillai et. al., reinforced the fact that axilla radiation was responsible for arm swelling. This effect is compounded by node positivity.

Kwan compared many ethnic groups and found that women with breast cancer related lymphedema had more lymph nodes removed and positive nodes irrespective of the ethnicity. They calculated that with every single node removal the risk of lymphedema increases to 4.1%. They also observed risk of edema was more with axillary node dissection compared to sentinel lymphnode biopsy [(45)].

Rockson in his review states that it is the extent of axillary dissection and not the lymph node involvement responsible for lymphedema [(13)]. This was substantiated by Norman et. al., in 2010 in a comparison with breast conservation surgery [(2)]. Another review by Coriddi et. al., similarly found increased incidence with axillary lymph node dissection [(47)].

Rovere et. al., in 2003 observed higher incidence with level III dissection compared to level I and II. The lymphedema associated with level I and II dissection led to localised limb swelling. Hence they recommended site specific limb measurement. They further stressed on the fact that preoperative and post operative limb measurements were an accurate tool to follow up these patients. Apart from extent of dissection, they also found node positivity and dominant side was a significant edema contributing factor [(32)].

Hayes et. al., demonstrated that extensive surgery increased the risk to six fold where as removal of more than 20 lymph nodes increases the risk to four fold independently [(36)].

Herd - Smith et. al., said that number of nodes involved was found to be unrelated to lymphedema. According to their study removal of more than 30 lymph nodes were associated with borderline significant risk of arm swelling [7].

Liao et. al., from Taiwan [31] say that number of lymph nodes removed and metastatic involvement of nodes did not contribute to lymphedema like Hinrich [8].

An interesting study by Purushottam et. al.,[60] revealed inverse ratio between node positivity and lymphedema. They proposed that patients with axillary node positive undergoing node dissection develop collaterals providing alternative drainage pathways and thus reducing lymphedema.

Stage of disease and tumour type

According to literature the advanced stage was associated with higher risk of lymphedema. However, Hinrich et. al., did not find positive correlation between disease stage and lymphedema. Norman et. al., compared the stage with chemotherapy and said the proportion of women experiencing lymphedema was similar in stages II, III and IV.

In the Indian scenario, according to Pillai et. al.,[35] the most common subtype was infiltrating ductal carcinoma. The presentation was late 42% locally advanced and 16 % with metastasis. They studied that pathological nodal stage III was a significant risk factor.

A study in Africa revealed that presentation was generally late. They found that greater tumor size, clinically demonstrable axillary nodes, metastasis and locoregional recurrence were common. Clinical node positivity, metastasis and recurrent disease were independent risk factor of lymphedema [61]

Coriddi et. al., reviewed that stage III was associated with risk of upper limb symptoms [47]. Similar results were obtained by Kwan et. al., [45] and Deo [34].

In a study by Rockson the time interval since presentation was an unrelated factor to lymphedema [13].

Stage of the disease involving tumour histology grade and size determines the treatment modality and the regimen; this indirectly influences the risk of lymphedema [3,7]. The receptor status too has an indirect effect on risk of lymphedema. It influences the treatment decision.

Wound drainage and infection

The common complications after breast cancer surgery are prolonged seroma drainage, seroma infection, cellulitis, abscess, wound dehiscence, skin partial or complete necrosis and hematoma. This may cause morbidity, and delay chemotherapy, radiation and rehabilitation.

Tadych et. al., concluded that wound drainage more than 900ml had greater than 75% rate of arm edema whereas less than 550 ml drainage did not develop lymphedema. The mount and duration of drainage did not co-relate with body weight. The persistent and seroma and lymphedema was extensive brachial lymphatic destruction. They advised closed suction drainage to continue till 24 hours drainage was less than 20 ml [4].

Fu et. al., in their study involving 130 patients observed that women with "symptomatic" seroma had higher risk of lymphedema in future. The symptoms included swelling, chest / breast swelling, heaviness, tightness, firmness, pain, numbness, stiffness, or impaired limb mobility. He recommended prophylactic preventive measures for such groups[62].

Wound drainage reduced if the tissue handling was gentle along with usage of drain and external compression [63]. It also reduced the changes of wound infection and dehiscence. In the 2013 Cochrane meta-analysis [64] assessing wound drainage after axillary dissection, no

significant incidence of lymphedema or hematoma formation was noted was found with no drainage. They concluded that quality of evidence was limited to assert the drain insertion reduced the seroma formation and aspiration.

In another systemic analysis by Kuroi et. al., they mention that breast conservation surgery reduced the chances of seroma formation. They did not find any strong correlation between tumour type with hormone receptor status, stage, volume and duration of seroma drainage, amount of negative suction, number of lymph node positive/ removal and use of fibrin sealant [65]. Hinrichs too declared that postoperative wound infection and duration od seroma drainage were not risk factors for lymphedema [8].

Use of compression bandage around the chest did not reduce the wound drainage and of seroma. It rather increased the risk of seroma [66].

Chemotherapy

Anthracycline based chemotherapy is found to be a risk factor according to many observers [2, 34, 57]. A hazard ratio of 1.46 was calculated by Norman et. al., for chemotherapy causing lymphedema. According to their observation anthracycline based regimen were associated with higher risk of lymphedema after chemotherapy. Coriddi [47] assessed that chemotherapy increases the severity of lymphedema. They do not mention the regimen.

However, Pillai et. al., did not see and significance of chemotherapy causing lymphedema statistically [35]. No significant association of lymphedema with chemotherapy had been proved in a number of studies. A point to note is these studies do not clearly mention their regime [8, 31, 32, 69].

The mechanism of chemotherapy causing lymphedema is not known, The results were also confounding according to various studies. It is speculated that chemotherapy is a marker for advanced disease and advanced stage is generally associated with lymphedema.

The weight gain after chemotherapy is more important risk factor. The pathophysiology is not clearly known. Some chemotherapy drug regimen includes steroids like dexamethasone which may cause weight gain. The fatigue due to chemotherapy also reduces patients' activity rendering them sedentary. Another reason for weight gain may be hormonal changes due to chemotherapy.

Radiotherapy

Radiation to the post operative site has indication based on stage of the disease and the histological nodal status. It is an established cause of lymphedema in the post operative period. The risk increases many fold if axillary dissection is followed by radiation. The literature has confounding reports on the dosage and region involved. Appropriate planning and focussed radiation can reduce the incidence rates of lymphedema. Another factor to be considered is the post radiation dermatitis or necrosis. The superadded infection and inflammation can precipitate or worsen the condition. The incidence of lymphedema secondary to post mastectomy radiation ranges from 0% to 54% [(8)].

In the study done by Indian counterparts [(34, 35)] it was consistent to note that locoregional radiotherapy emerged as a significant risk factor leading to arm edema. The authors recommend avoidance of axillary dissection with radiation to reduce morbidity.

Erickson et. al., in their review concluded that axillary surgery with radiation increases the chances of lymphedema [(39)].

Liao et. al., found a risk correlation between radiotherapy to supraclavicular area and axilla. The dosage of radiation did not have an impact on the chances of arm swelling [(31)].

Hinrichs et. al., indicated that total dose, posterior axillary boost, overlap technique with boost to supraclavicular and internal mammary area resulted in lymphedema. As their study was small, multivariate analysis could not be done [(8)].

The various methods to reduce lymphedema following radiotherapy are [67]:

1. To use fractionated dosages (1.8-2Gy/day) total of 45-50 Gy may be used.
2. In case of supraclavicular radiation it would be better to leave a strip of normal skin. This facilitated collateral circulation and reduces risk of lymphedema.
3. Marking the dissected area with surgical clips to avoid radiation in those regions, This is helpful in level III radiation.

MANAGEMENT OF POST MASTECTOMY LYMPHEDEMA

The aim of treatment is to improve the physical characteristics of the affected limb and the quality of life thereby achieving,

— enhanced social adaptation and a socially useful life,

— Recovered functional adaptation with physically normal activity,

— Healthier psychological adaptation despite a psychologically unacceptable physical deformity.

Prior to commencement of therapy it is important to optimise the coexisting conditions like hypertension cardiac disease etc. The fluid shift during the therapy may cause congestive cardiac failure.

The treatment can be broadly divided into:

- Non surgical treatment
- Surgical treatment

The gold standard of treatment presently is complex decongestive therapy (CDT) . This incorporates various techniques including manual lymphatic drainage, compression devices, skin care, therapeutic exercises administered by therapists trained with CDT. It comprises of two phases.

- Phase I - acute patient management as outpatient setting. It consists of four week program of manual lymphatic drainage, short stretch compression bandaging, exercise with skin and nail care.
- Phase II - maintenance at home by patient or family, involves continued proper skin care and exercise, self massage and use of a compression sleeve and glove during day and bandaging at night.

Compression bandages gives a pressure of 20-60 mm Hg. The disadvantage is that it requires a long term care with change of bandages every six months. Use of compression sleeve has not been favourable.

Therapeutic exercises which include contraction and relaxation of muscles aids in drainage of collected lymph fluid. It is advised to do these exercises with the bandage on. Manual decongestive therapy is given by a therapist trained in graduated massage form distal to proximal region of the limb. This helps in draining lymph and reduces edema.

Compression bandaging can significantly reduce the edema and has been even proven beneficial in preventing lymphedema in high risk cases [(5)].

The pharmacological methods of applied are Benzopyrones, flavinoids, diuretics, hyaluronidase, pantothenic acis and selenium. The efficacies of these drugs are not established yet.

The surgical options are liposuction, fasciotomy, lymphaticovenous anastomsis and superficial lymphangiectomey. These procedures are based on the principles of creating alternate route of drainage mainly from dermal to deep lymphatics. Surgery is generally not indicated in patients with post mastectomy lymphedema.

Measures to prevent lymphedema

The best way to reduce the incidence of arm edema lies in its prevention. There are no randomised controlled trials to prove which method of prevention is effective.

Treatment strategies to reduce risk like sentinel lymph node dissection instead of axillary dissection has been proven beneficial. Detection of lymphedema in subclinical stage with the use of bioimpedance spectroscopy can help instituting early measures like compression garment or bandage.

There are certain practices encouraged among the patients to decrease the chances of arm edema. The four categories of prevention are

- Avoidance of trauma
- Infection prevention
- To avoid arm constriction
- Use of exercise of the limb.

Aims and Objectives

AIMS AND OBJECTIVES

AIM:

- To study the incidence and factors influencing post mastectomy lymphedema.

OBJECTIVES:

- To study the incidence of upper limb lymphedema in patients undergoing mastectomy.
- To study the factors responsible for the development of lymphedema.
- To predict the risk of lymphedema in a patient based on contributing factors after immediate postoperative period.

Materials and Methods

MATERIALS AND METHODS

The research was carried out at the Department of Plastic Surgery and Endocrine Surgery, Christian Medical College Hospital, Vellore. The study was approved by the International Review Board and ethics committee, Christian Medical College, Vellore.

Duration of the Study was 1 year and 6 months

There was no source of Monetary or Material Support.

Inclusion criteria

Adult women diagnosed with breast cancer.

Exclusion criteria

Males

Filarial upper limb lymphedema

Congenital lymphedema or vascular malformations

Lymphomas involving breast or axilla

Sample size calculated: 80-100 cases

119 Newly diagnosed cases of carcinoma breast were assessed preoperatively on the basis of history, age, co- morbidities especially hypertension and BMI. The women were also assessed for any upper limb abnormality like prior injury or shoulder stiffness of the affected side. Preoperative measurements of affected upper limb were taken from fixed bony points in arm and forearm. The measurement was done using a measuring tape with fixed distance of 5 cm interval in the arm and the forearm.(fig4) Distally wrist and the girth of index finger were measured.

Serial measurement were taken at 1, 3, 6 months and 1 year post surgery.

The histopathology was followed for the number of nodes involved and the number of nodes removed along with the final stage of the disease.

In the Postoperative period, patients were assessed on the amount and duration of drainage of seroma. They were observed for the signs of infection.

The proposed treatment was continued. The chemotherapy regimen was noted. The effect of radiotherapy on the local area was assessed.

Patients were assessed for development of lymphedema by serial measurement and were broadly separated into 2 subgroups:

- Without clinical swelling
- Clinical edema: can be appreciated by the patient easily or increase in size more than 2cm.

The patients with edema more than 2cm were diagnosed to have lymphedema.

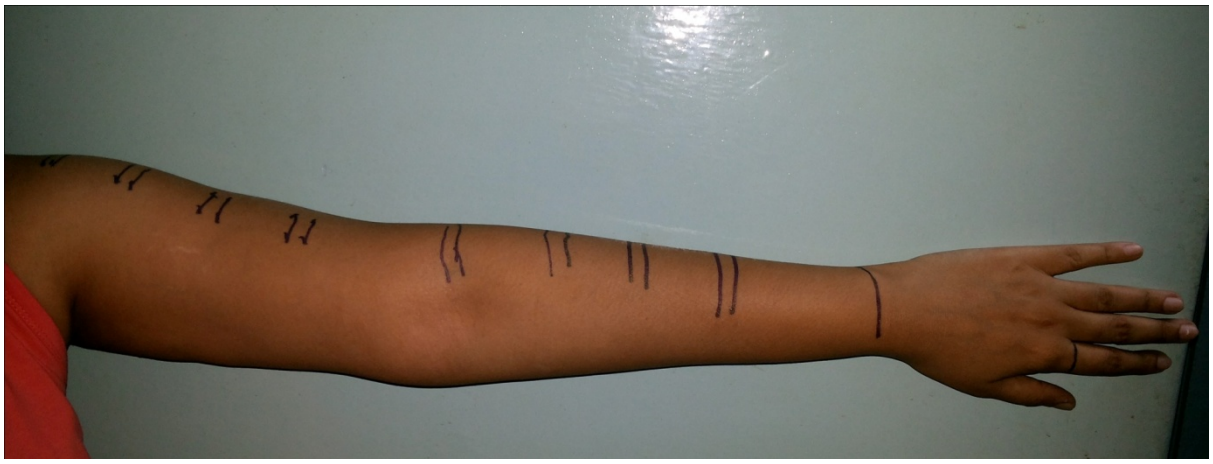


Fig 4 : Markings of the measurement

The risk factors evaluated were

1. Age distribution
2. Body mass index
3. Comorbidity
4. Hypertension
5. Medication
6. Socioeconomic status
7. Upper limb symptoms
8. Laterality of disease side
9. Type of surgery
10. Stage of the disease
11. Histopathology
12. Node status
13. Wound complication
14. Receptor status
15. Seroma dranaage
16. Duration of seroma drainage
17. Radiotherapy
18. Chemotherapy
19. Post radiation skin reaction
20. Post therapy weight gain

STATISTICAL ANAYISIS

The statistical analysis was done using Chi Square Test with SPSS version 16.

Results

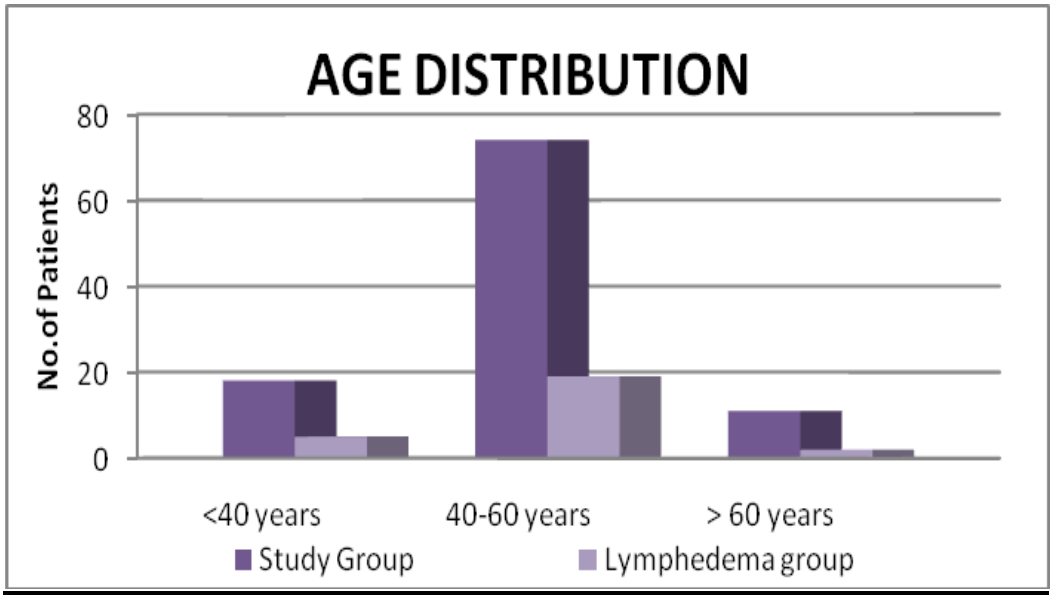
RESULTS

In this study, total number of patients recruited was 119. Four Patients expired and 12 were lost to follow up. The total number of patients who completed the study was 103. Twenty six patients developed lymphedema over one year thus the incidence of lymphedema was found to be 25.24%.Individual risk factors were assessed separately for statistical significance as a risk factor.

AGE DISTRIBUTION

AGE INTERVAL	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
< 40 years	17.5 (18)	27.7 (5)	72.3 (13)	0.84
41-60 years	71.8 (74)	25.7 (19)	74.3 (55)	
> 60 years	10.7 (11)	18.2 (2)	81.8 (9)	

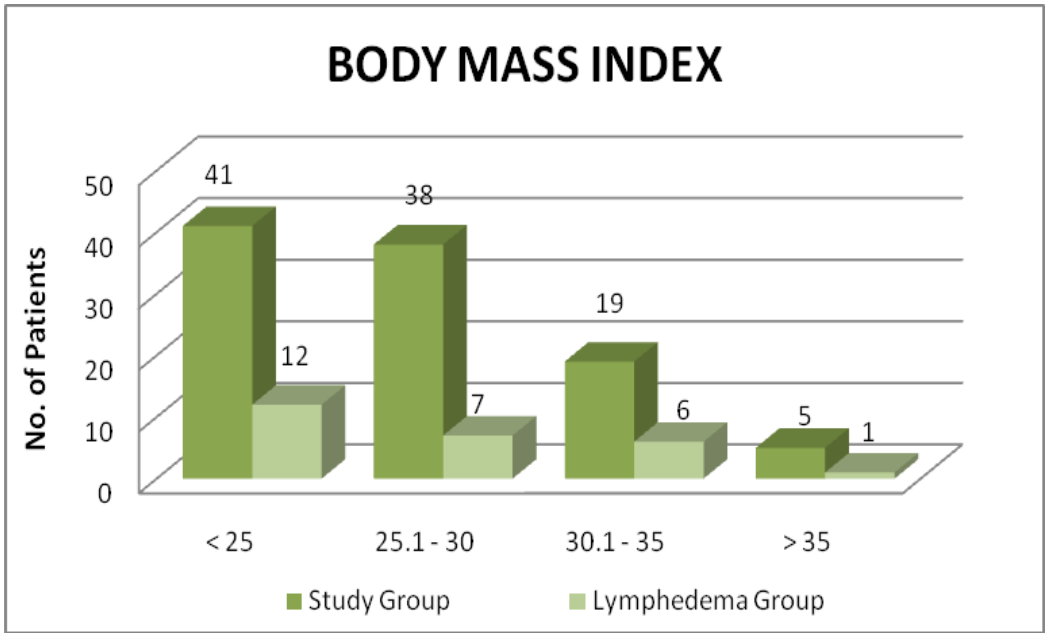
The common age group was 41-60 years comprising of 74% of the patients. Among the women who developed lymphedema, 19 out of 26 women were in the same range. We see a trend towards greater number breast cancer among women less than 60 years. 88.5% of women who developed lymphedema were younger than 60 years. However, the age did not have a positive statistical correlation as a risk for lymphedema.

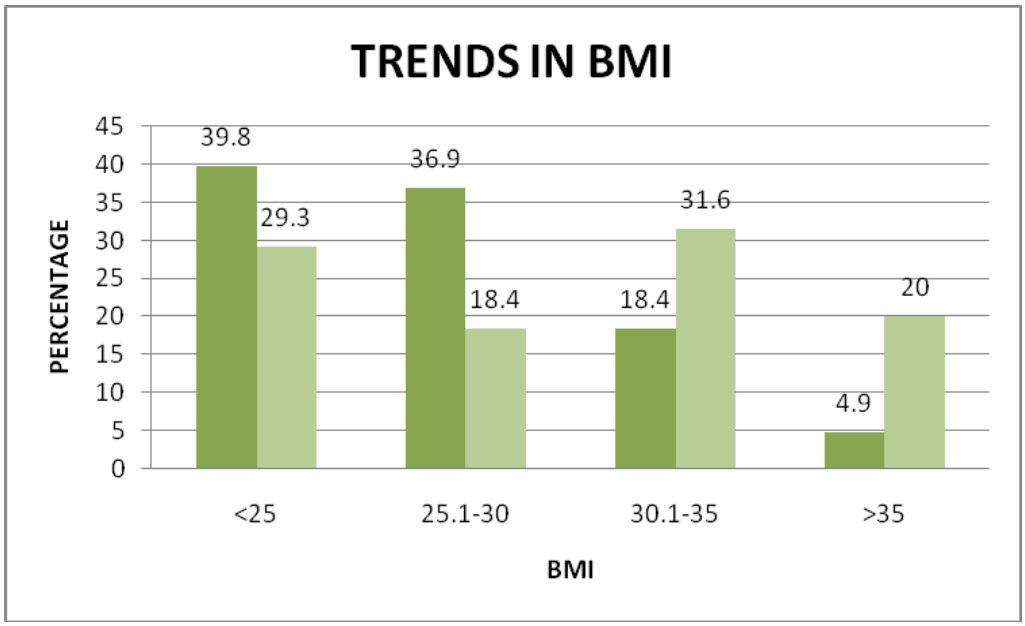


BODY MASS INDEX

BODY MASS INDEX	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
<25	39.8 (41)	29.3 (12)	70.7 (29)	0.622
25.1-30	36.9 (38)	18.4 (7)	81.6 (31)	
30.1-35	18.4 (19)	31.6 (6)	68.4 (13)	
>35	4.9 (5)	20 (1)	80 (4)	

Most of our patients were not obese. 76.7 % of women were BMI less than or equal to 30. Even in the lymphedema group only one patient had BMI more than 35. Statistically, Obesity was not found to be a significant factor.



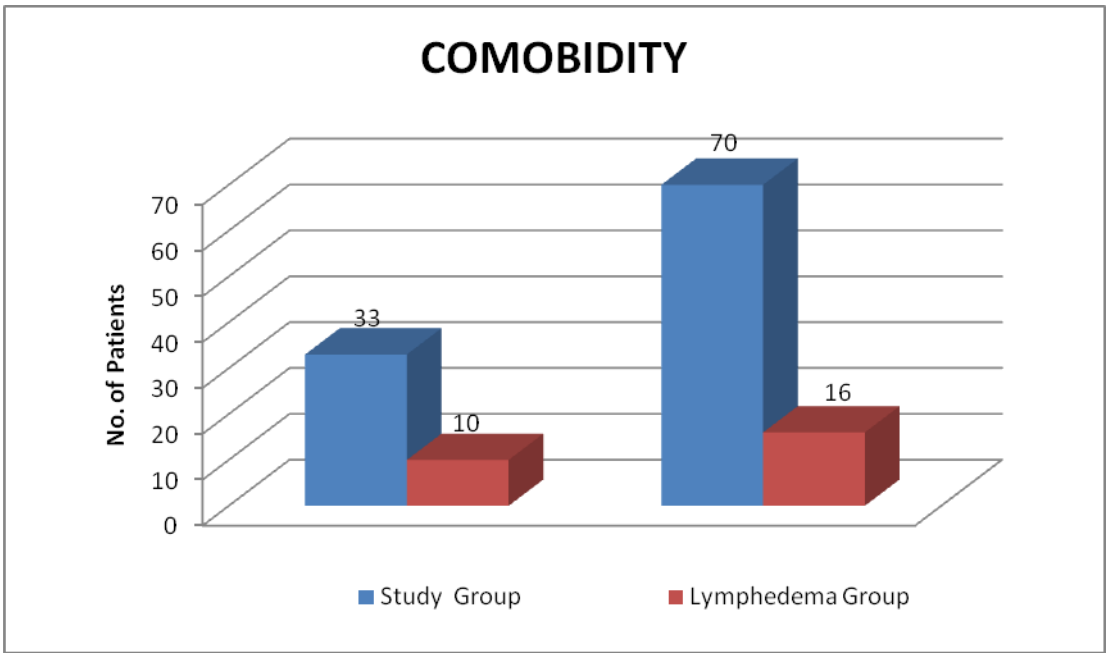


Obesity is not yet a prevalent condition among the lower socioeconomic strata from where our patients belong. There is downward trend between number of patients and rise in BMI in the study group. The trend was fluctuating type in the lymphedema group.

COMORBIDITY

COMORBIDITY	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Present	32 (33)	30.3 (10)	69.7 (23)	0.47
Absent	68 (70)	22.9 (16)	77.1 (54)	

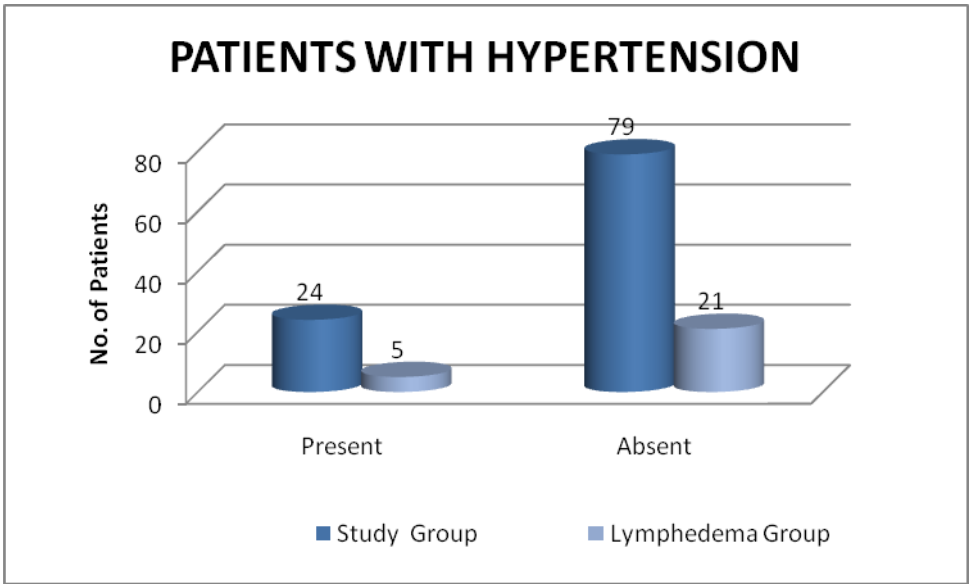
Presence of co-morbidity did not correlate with the risk of developing lymphedema. 32 % of the women had co- morbid conditions in the form of diabetes, heart disease or renal disease. 30 % of this group were positive for lymphedema. Among the patients with lymphedema 16 patients did not have any co-morbid condition.



HYPERTENSION

HYPERTENSION	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Present	**23.3 (24)**	**20.8 (5)**	**79.2 (19)**	**0.789**
Absent	**76.7 (79)**	**26.6 (21)**	**73.4 (58)**	

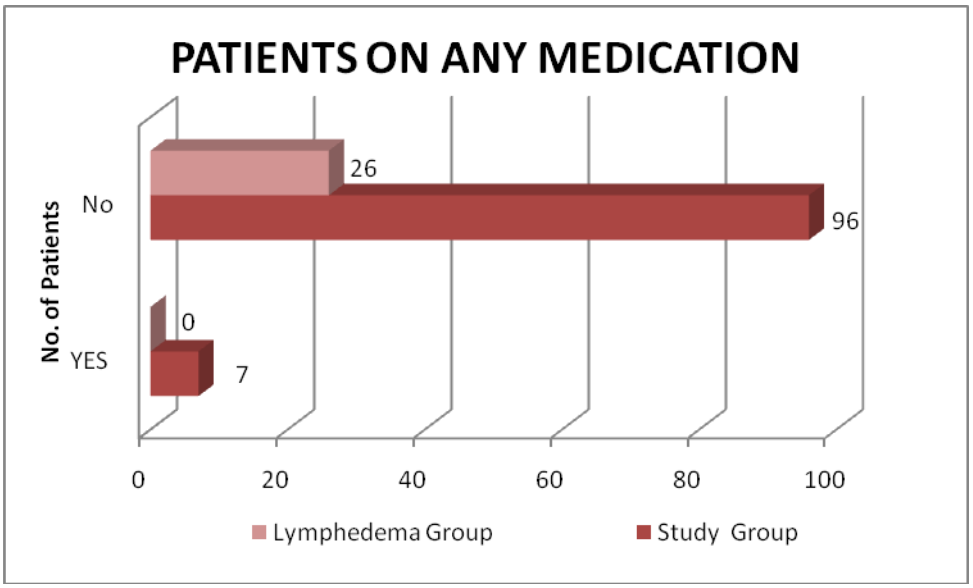
Hypertension was taken as a separate risk factor. Interestingly, in our study it is not a significant risk factor leading to limb swelling. 23.3% of the total patients were hypertensive. In our study, only 5 women with hypertension developed lymphedema.



MEDICATION

MEDICATION	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Yes	6.8 (7)	0	100 (7)	0.187
No	93.2 (96)	27.1 (26)	72.9 (70)	

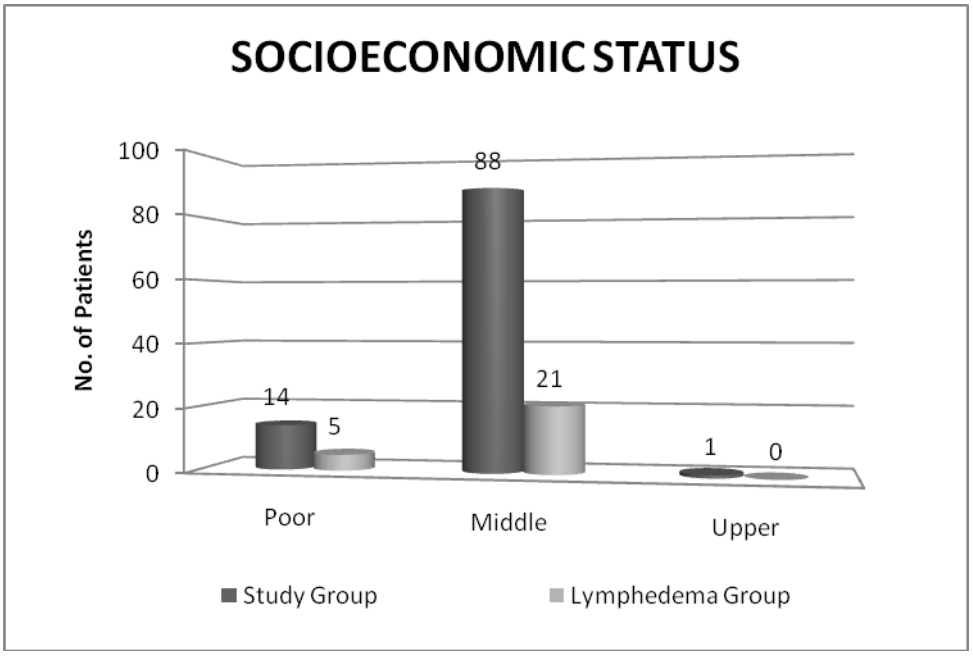
Many drugs have been held responsible for lymphedema. However, in our study none of the patients were found to develop lymphedema who were on medication.



SOCIOECONOMIC STATUS

SOCIOECONOMIC STATUS	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Poor	**13.6 (14)**	**35.7 (5)**	**64.3 (9)**	**0.538**
Middle	**85.4 (88)**	**23.9 (21)**	**76.1 (67)**	
Upper	**1 (1)**	**0**	**1 (1)**	

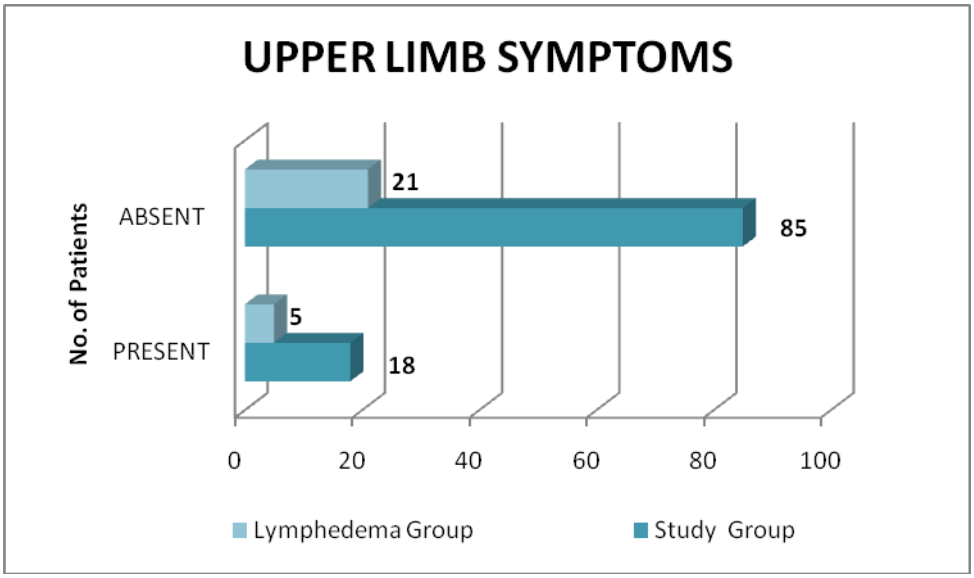
Most of the patients were of middle class income group, followed by poor patients. Low socioeconomic status was not a risk factor for lymphedema after mastectomy.



UPPER LIMB SYMPTOMS

UPPER LIMB SYMPTOMS	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Present	17.5 (18)	27.8 (5)	72.2 (13)	0.771
Absent	82.5 (85)	24.7 (21)	75.3 (64)	

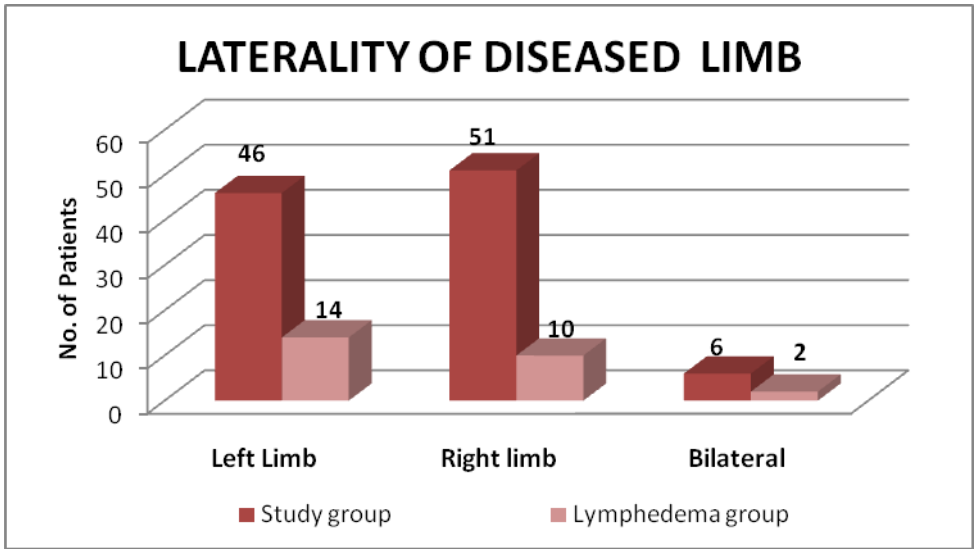
Patients were evaluated for preoperative upper limb symptoms like pain, arthralgia, trauma or previous infection. Only five patients in lymphedema group had preoperative symptoms. Most of the women in the study denied any symptoms or history before surgery. Thus there was no statistical significance of upper limb symptoms or abnormality and risk of lymphedema.



LATERALITY OF DISEASE SIDE

DISEASE SIDE	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Left	**44.7 (46)**	**30.4 (14)**	**69.6 (32)**	**0.422**
Right	**49.5 (51)**	**19.6 (10)**	**80.4 (41)**	
Bilateral	**5.8 (6)**	**33.3 (2)**	**66.7 (4)**	

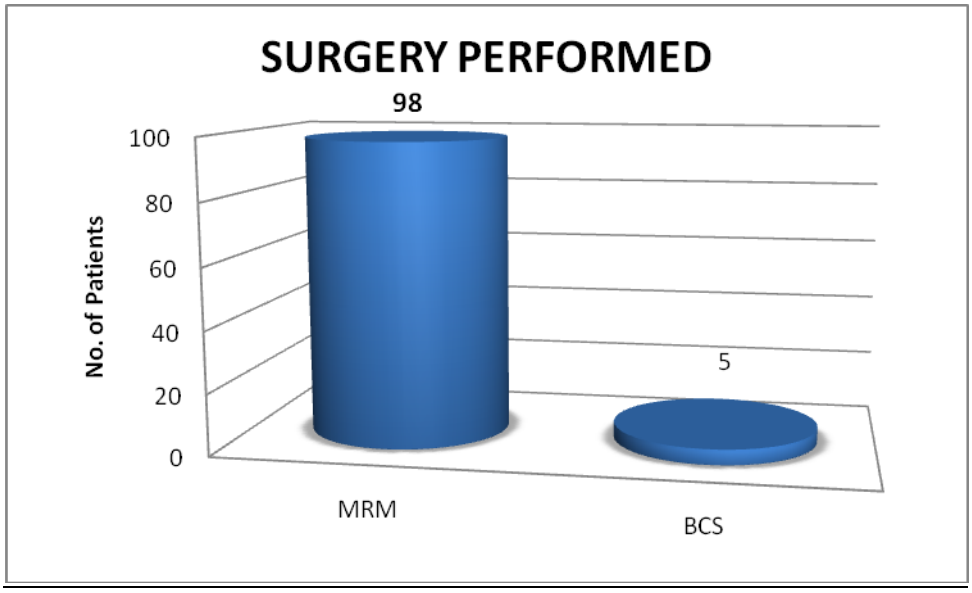
The number of right sided disease was marginally higher than the left side. Six patients had bilateral disease. Among the women who developed lymphedema, 30.4% of the study group had left sided disease. Two patients had bilateral disease. No correlation was seen between side of breast carcinoma and risk of lymphedema.



TYPE OF SURGERY

SURGERY	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
MRM	95.1 (98)	26.5 (26)	73.5 (72)	0.327
BCS	4.9 (5)	0	100 (5)	

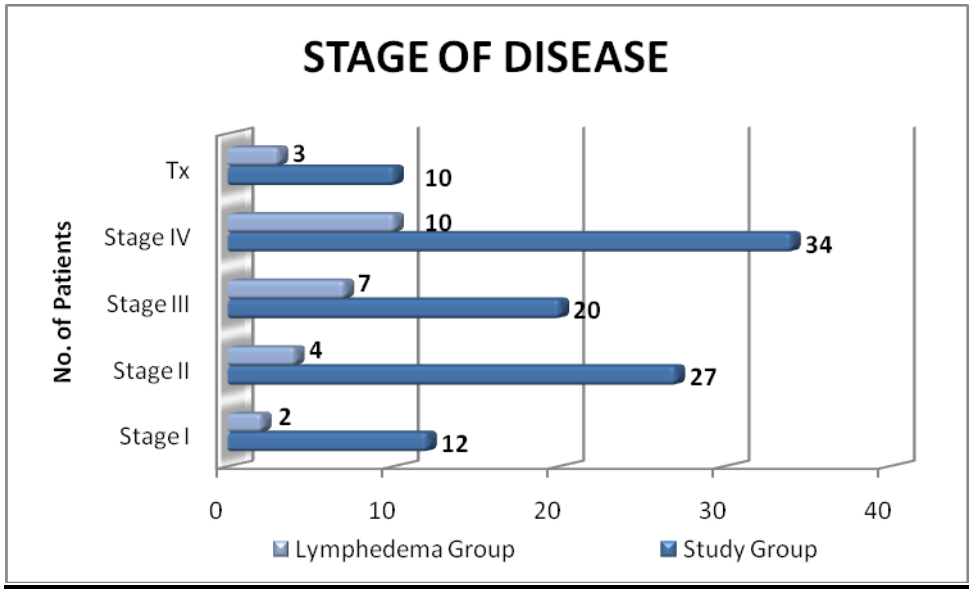
All the patients who developed lymphedema underwent modified radical mastectomy. 95% of the patients underwent modified radical mastectomy. Type of surgery was not a risk factor for lymphedema. There was no incidence of lymphedema among the patients who underwent breast conservative surgery (BCS). However the number was too small to show the significance.



STAGE OF DISEASE

STAGE	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
I	11.7 (12)	16.7 (2)	83.3 (10)	0.483
II	26.2 (27)	14.8 (4)	85.2 (23)	
III	19.4 (20)	35 (7)	65 (13)	
IV	33 (34)	29.4 (10)	70.6 (24)	
TX	9.7 (10)	30 (3)	70 (7)	

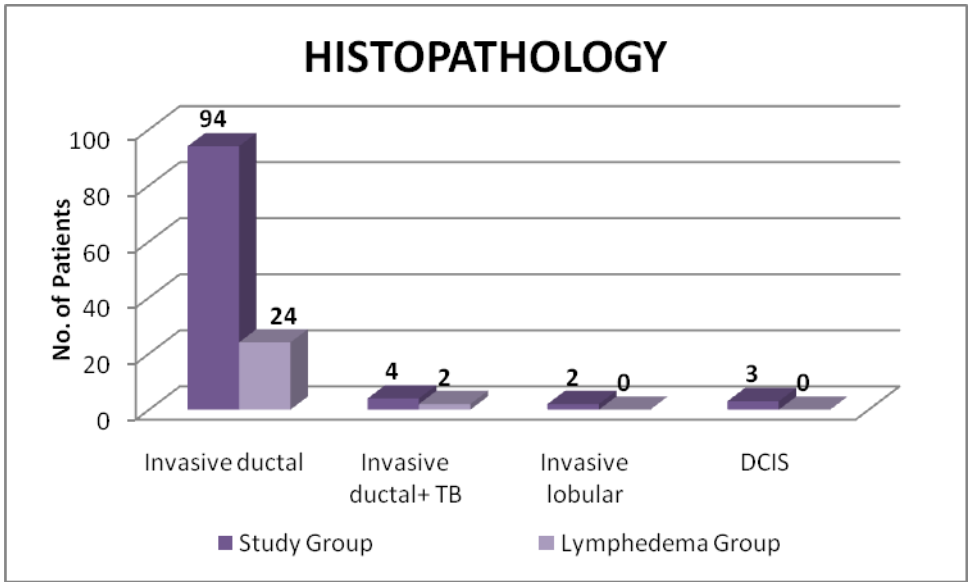
A wide range was seen in all the stages. 33% belonged to stage IV. Also in lymphedema group maximum number was seen in stage IV. This was followed by stage III and then Stage II. However, stage of the disease did not have statistical significance as risk factor for lymphedema.



HISTOPATHOLOGY

HISTOPATHOLOGY	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Invasive ductal	91.3 (94)	25.5 (24)	74.5 (70)	0.393
Invasive ductal+ TB	3.9 (4)	50 (2)	50 (2)	
Invasive lobular	1.9(2)	0	100 (2)	
DCIS	2.9 (3)	0	100 (3)	

The most common tumour type was infiltrating ductal carcinoma 91.3%. There were four patients with associated tuberculosis. 50 % of these women developed lymphedema. As the invasive ductal type was most common variety of tumour, no statistical significance was seen.



NODE STATUS

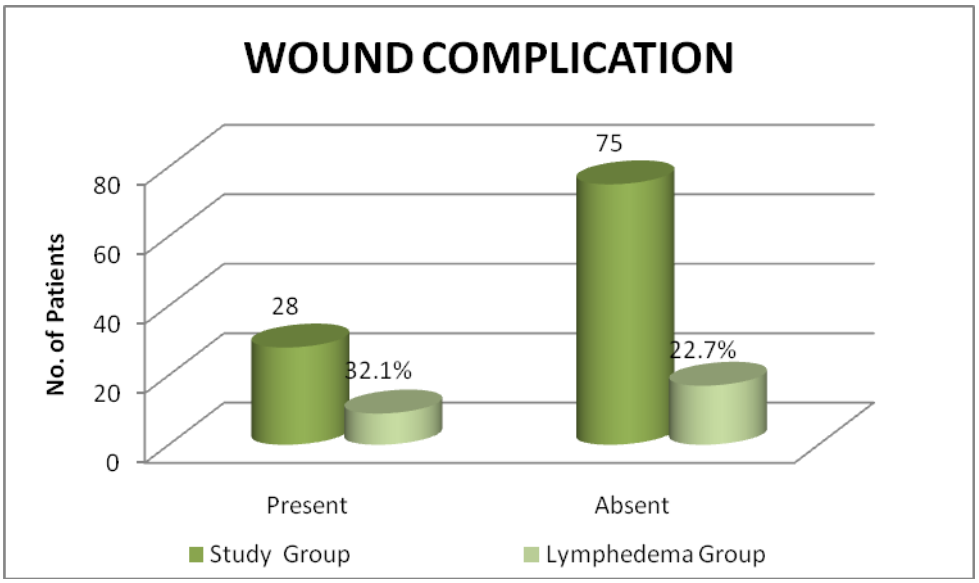
The mean number of nodes removed 13.06 (0-28).

The mean number of nodes involved 2.27 (0-17).

WOUND COMPLICATION

WOUND COMPLICATIONS	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Present	27.2 (28)	32.1 (9)	67.9 (19)	0.322
Absent	72.8 (75)	22.7 (17)	77.3 (58)	

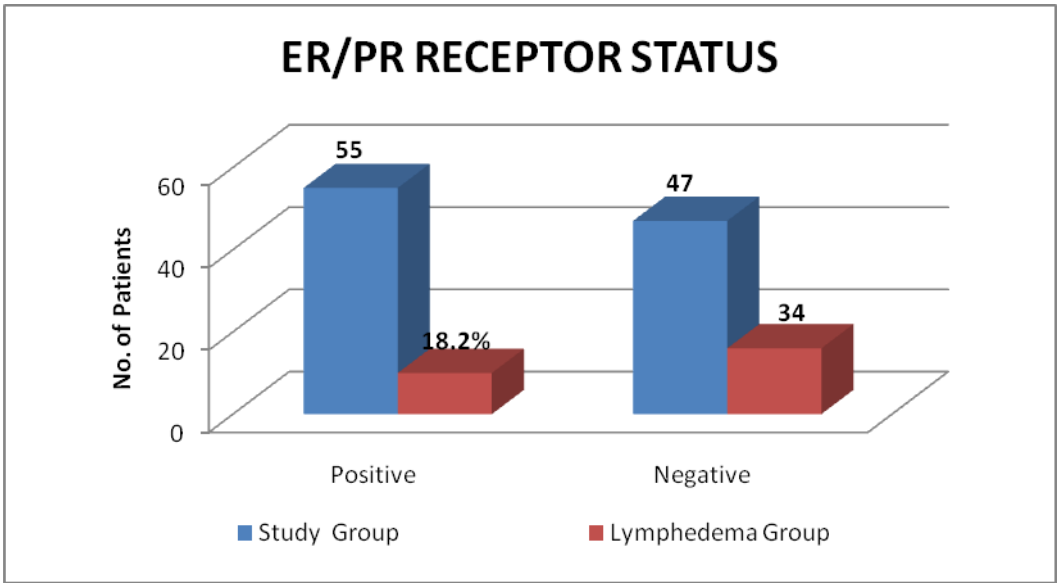
Wound complications like suture line dehiscence, flap necrosis, seroma infection were observed for lymphedema. We found that, the incidence of wound complication was 27.2 percent. Nine women with wound complication developed lymphedema. However, this too was proven as a insignificant factor according to statistics.



RECEPTOR STATUS

RECEPTOR STATUS	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
ER/PR Positive	53.9 (55)	18.2 (10)	81.8 (45)	0.074
ER/PR Negative	46.1 (47)	34 (16)	66 (31)	

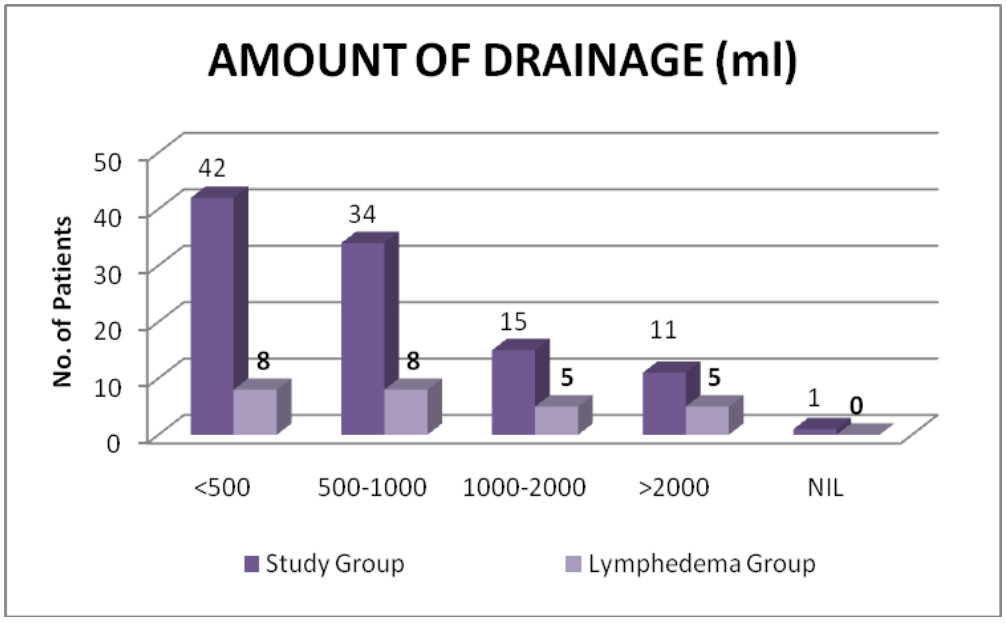
In this study, the receptor status was not mentioned for one patient. More than 50% of the women were estrogen progesterone receptor positive. 16 patients who developed lymphedema were receptor negative. Statistically it was not a risk factor but was closely related.

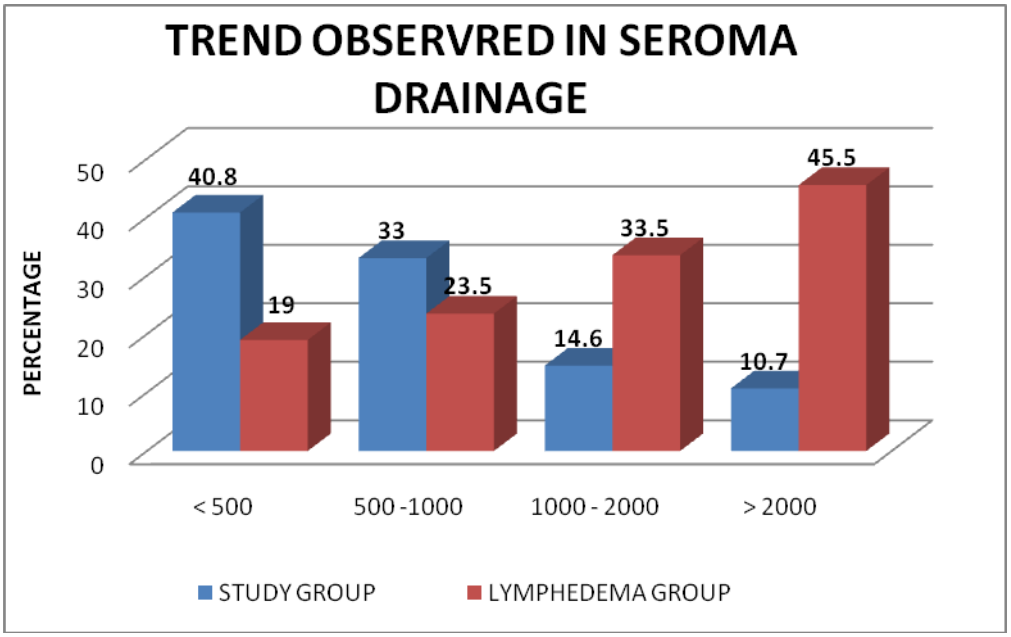


SEROMA DRAINAGE

DRAINAGE (ml)	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
< 500	**40.8 (42)**	**19 (8)**	**81 (34)**	**0.387**
500 -1000	**33 (34)**	**23.5 (8)**	**76.5 (26)**	
1000 - 2000	**14.6 (15)**	**33.5 (5)**	**66.7 (10)**	
> 2000	**10.7 (11)**	**45.5 (5)**	**54.5 (6)**	

The amount of seroma drainage was also found not a significant factor causing lymphedema. There was an almost equal distribution of quantity of seroma drainage in the women with lymphedema



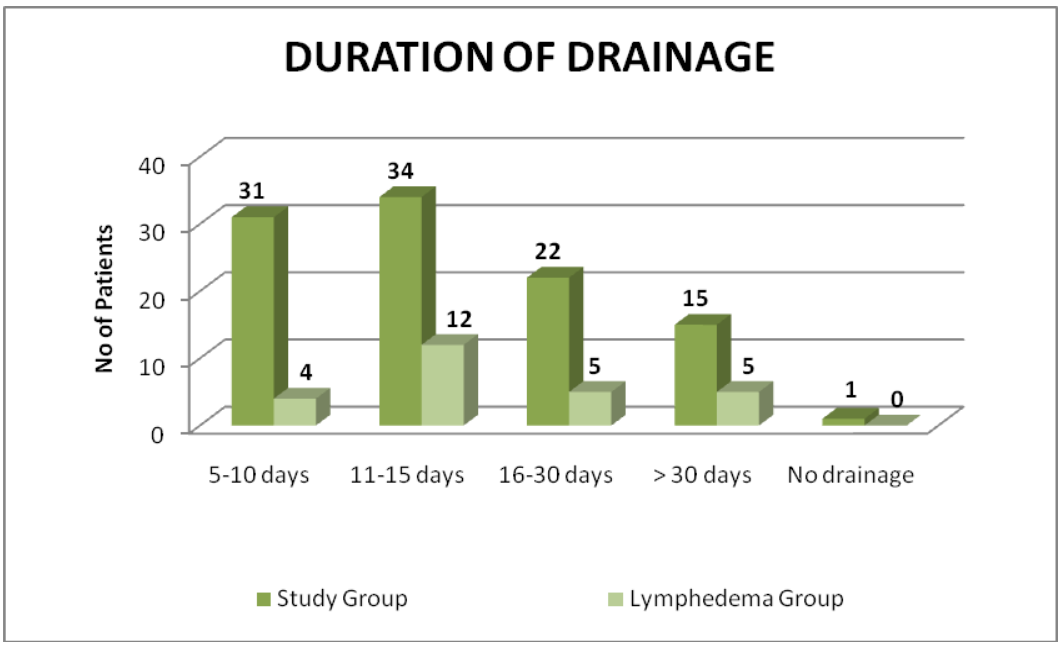


There was a rising trend of more drainage among lymphedema group. As the number of subjects were less P value is not significant.

DURATION OF SEROMA DRAINAGE

DURATION OF SEROMA DRAINAGE	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
5-10 days	30.1 (31)	12.9 (4)	87.1 (27)	0.181
11-15 days	33 (34)	35.3 (12)	64.7 (22)	
16-30 days	21.4 (22)	22.7 (5)	77.3 (17)	
> 30 days	14.6 (15)	33.3 (5)	66.7 (10)	

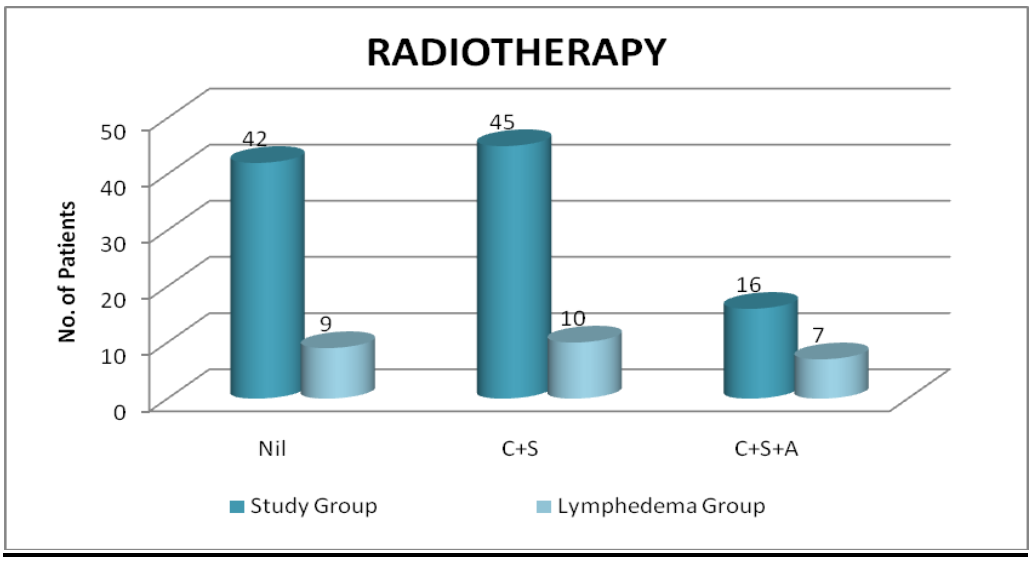
We did not find the duration of drainage of seroma as a risk factor as its P value was 0.181. However, among 15 patients who had a prolonged duration of drainage of more than 30 days, 5 developed lymphedema. 30% of Patients had seroma drainage for less than 10 days. 15.3% (4/26) of patients in lymphedema had duration of drainage less than 10 days. 84.6% had drainage more than 10 days. P value on comparing drainage duration more than 10 days and less than 10 days was 0.05. This signifies seroma drainage of more than 10 days as risk factor. However, more number of patients was required for prove stronger correlation.



RADIOTHERAPY

RADIOTHERAPY	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
No radiation	40.8 (42)	21.4 (9)	80.5 (33)	0.179
Chest + Supraclavicular (C+S)	43.7 (45)	22.2 (10)	77.8 (35)	
Chest+ Supraclavicular +Axilla(C+S+A)	15.5 (16)	43.8 (7)	56.2 (9)	

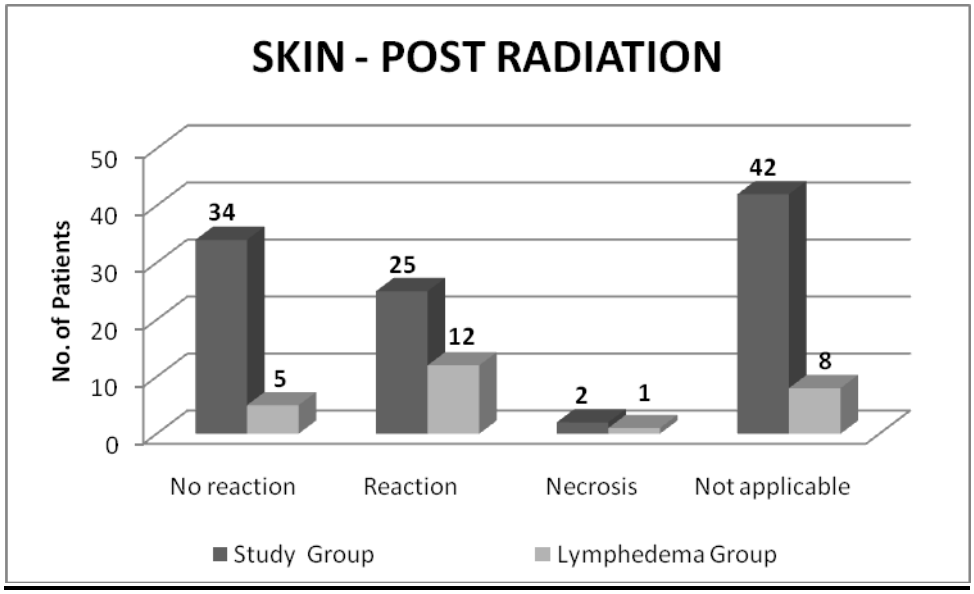
40% of women with breast cancer did not require radiotherapy. This also included the women who refused radiotherapy after surgery. 43.7 % underwent radiation to chest and supraclavicular area. 15.5% received radiation to axilla as well. 10 out of 26 women who developed lymphedema, had their chest and supracalvicular area radiated. There was a rising trend towards lymphedema in patients with more extensive radiation. Statistic significance for Radiotherapy as a risk factor for lymphedema could not be demonstrated.



POST RADIATION SKIN REACTION

SKIN – POST RADIATION	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
No reaction	**33.0 (34)**	**14.7 (5)**	**85.3 (29)**	**0.020**
Reaction	**26.2 (27)**	**44.4 (12)**	**55.6 (15)**	
Not applicable	**40.8 (42)**	**19 (8)**	**81 (34)**	

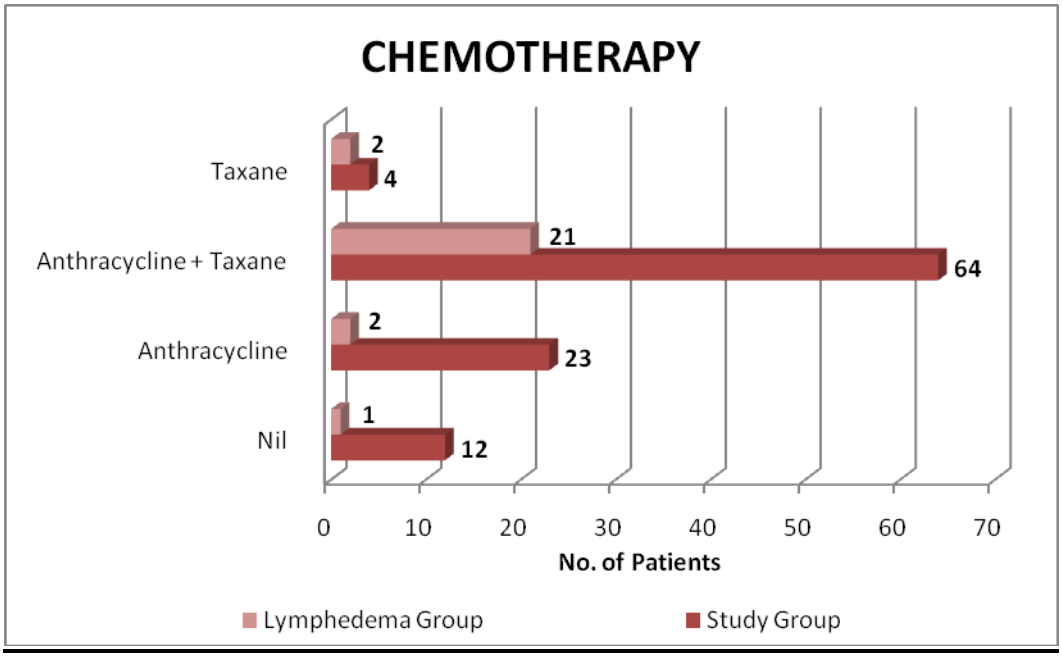
Twelve patients developed post mastectomy skin reaction at the radiation site. Out of these twelve one patient had skin necrosis. In eight patients radiation was not given and five did not have any skin complications after therapy. Skin reaction or radiation was statistically a significant factor of the risk of lymphedema.



CHEMOTHERAPY

CHEMOTHERAPY	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Nil	11.7 (12)	8.3 (1)	91.7 (11)	0.038
Anthracycline	22.3 (23)	8.7 (2)	91.3 (21)	
Anthracycline + Taxane	62.1 (64)	32.8 (21)	67.2 (43)	
Taxane	3.9 (4)	50 (2)	50 (2)	

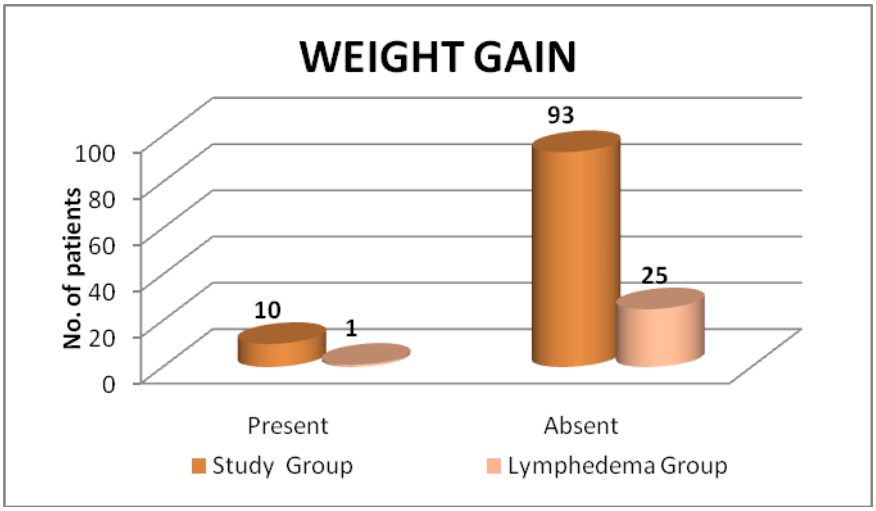
Chemotherapy was found to be a risk factor for lymphedema. Majority of women received anthracycline based chemo regimen. In the lymphedema group, 23 of the 26 patients who received anthracycline based chemotherapy. Thus anthracycline based chemo therapy may be a risk factor.



WEIGHT GAIN

WEIGHT GAIN	STUDY GROUP % (n)	LYMPHEDEMA GROUP % (n)	LYMPHEDEMA ABSENT % (n)	P value
Yes	**9.7 (10)**	**10 (1)**	**90 (9)**	**0.445**
No	**90.3 (93)**	**26.9 (25)**	**73.1 (68)**	

Only one patient who developed lymphedema after mastectomy had weight gain during therapy. This was not found as a risk factor. 93% of the women did not complain of weight gain.



Discussion

DISCUSSION

Lymphedema has multiple risk factors associated with it. According to the literature no consistent finding is seen pertaining to well defined risk factors responsible for lymphedema. There are many reasons for this inconsistency. As stated earlier, the method of measurement of lymphedema varies from study to study. Another reason was the sample size of the study.

The incidence of lymphedema in our institute was 25.24% in one year. As per Guedes Neto the incidence of arm edema within one year of breast cancer treatment was 73% [(69)]. The wide range of lymphedema after breast cancer surgery is from 5-60 %. In the Halsteadian era, radical surgery led to greater incidence of lymphedema with great morbidity. Evolution of advanced diagnostic techniques has led to early diagnosis of the condition. Awareness among the women in western country with aggressive screening programmes has also contributed to early diagnosis of the disease. According to some studies early stages were associated with decreased incidence of lymphedema. This was due to less extensive surgery and node dissection. Also in western countries the awareness of lymphedema is widespread with multiple lymphedema communities for aftercare and support group. The identification of patients at risk of developing lymphedema helps in close follow up with early intervention to prevent progression. Many centres provide prophylactic bandages to patients as preventive measure.

The conditions are different in India. Most of the presentation is late in stage III or IV. This leads to extensive node dissection and aggressive post surgical therapy hence they indirectly contribute to lymphedema. The awareness among women on lymphedema is low and not well understood. In a typical Indian household scenario, many manual activities are required. This makes them prone for injuries and thus infection. We educate the women on

the postoperative aftercare but we observed that, is not strictly followed by the patients. It is said that breast cancer is the disease of working women [2]. This finding was refuted in our study. Many of our patients were homemakers. The Indian patient is different from a western one. Most of the studies have been done on western patients mainly whites. Thus simulation of study with application to Indian scenario may not produce similar results.

The statistical significant risk factors according to our study were chemotherapy and skin involvement after radiotherapy. As stated earlier, most of the patients were in stage III and IV requiring aggressive chemotherapy and radiotherapy. The common regimen used in our institute was anthracycline based. According to Norman et. al., anthracycline based chemotherapy was a significant risk factor for post mastectomy lymphedema [2].Similar finding was observed with Deo et. al., [34] However in our study the sample size was small. Hence many factors which appeared significant could not be proven statistically.

Majority of the patients who developed lymphedema after radiotherapy had skin involvement after radiotherapy in the form of skin necrosis. Two patients developed skin necrosis of the post operative radiation site. Al though this variable was significant statistically, the larger sample size would have aided in defining the role of regional radiation in causing arm edema. Many studies state radiotherapy especially to axilla as a risk factor [34,39] . Here it could not be proved statistically. Axillary radiation was avoided unless necessary based on tissue and node biopsy status.

Another factor which seemed weakly significant was receptor status. We found that 15.5% of the total patients were receptor negative and developed lymphedema. Sixteen of the 26 patients were negative or Estrogen and progesterone receptors and developed lymphedema. As mentioned before, larger sample size would have been better to explain in statistical terms. Negative estrogen receptor status as a risk factor for lymphedema has been

supported by few studies. The receptor status decides the chemotherapy regimen of the patients. Hence it indirectly contributes as the risk factor for lymphedema.

The age of the patient did not have any strong correlation statistically but we observed that most of our women were in the age group of 40-60 years. The incidence of breast cancer and lymphedema was also high among the women less than 60 years. These findings were consistent with studies done by Norman [(2)], Armer [(41)] and Parbhoo [(42)]. This is due to active lifestyle of younger women making them prone to injuries. Another possible reason can be aggressive tumour stage and subsequent therapy. It requires further studies to explain the cause of malignancies in early age group in our country.

Obesity as a factor for lymphedema was refuted as majority of our patients (76%) had BMI less than 30. Majority of the women were not overweight or obese.95% of the patients had BMI less than 30. Hence there was no statistical significance between obesity and risk of lymphedema. As per the Asian study by Liao et. al., [(31)], the oriental women built is different compared to Caucasian women hence they proposed that criteria of diagnosis may change according to ethnicity. Similar situation applies to Indian subgroup also. It is difficult to restrict criteria as each ethnic subgroup has specific structural composition and lifestyle habits.

Since the women were belonging to middle age group, there were lesser morbidities associated. Co - morbid conditions especially hypertension may be risk factor for lymphedema [(13,34,57,58)] . We did not find a statistical significance between comorbid conditions, hypertension and lymphedema. Also, majority our patients were not on any medications which could contribute to lymphedema.

Preoperative upper limb symptoms in the form of shoulder pain, restricted movement and previous fractures were not found to be risk factor for lymphedema. Most of our patients

resume daily activities of self care in early post operative period. Post operative exercise were encouraged hence upper limb symptoms were not pronounced among the women after mastectomy.

Side of the disease could not be proven as a risk factor and there was nearly equal distribution of carcinoma breast. Only two patients had bilateral disease and had developed lymphedema on both sides. Also, their disease was advanced stage.

The stage of presentation of the patients was generally advanced (62.1%). Ad discussed earlier, the advanced stage was associated with lymphedema. 20/26 of the patients with lymphedema had advanced disease. This appears a significant factor causing postoperative arm edema. The analysis was not consistent with our argument as more number of cases was required. The cause of late presentation was due to poor awareness among the patients. There was a difficulty in accepting and understanding the condition which delays the treatment further. Also the Indian women are hesitant to reveal the problem to the relatives as it involves a private area and fear stigmatization.

The presentation of patient with carcinoma breast was late. The commonest surgery performed was modified radical mastectomy. Breast conservation surgery was done for very few women. None of the women who developed lymphedema underwent breast conservation surgery. However the number was small to show significance. The commonest histopathology was infiltrating ductal carcinoma. We had 4 cases of patients with coexisting tuberculosis. Out of the 4 patients two developed lymphedema. Poor socioeconomic background may be responsible for such condition. The mean number of nodes removed 13.06.The mean number of nodes involved 2.27. The number nodes removed did not have correlation with risk of lymphedema.

27% of the patients had wound complications in the form of suture line dehiscence, marginal necrosis of the suture line, seroma infection and seroma abcess. 9 out of 26 patients had lymphedema with positive history of wound complication. However we need to have more patients in the study to prove statistical significance. The most common complication was suture line dehiscence.

The duration and amount of seroma drainage was studied. 40 % of the patients had total seroma drainage of less than 500 ml. Duration of drainage was less than 15 days in 63% of the patients. Among the lymphedema group there was almost equal distribution of the duration and quantity of seroma drainage as the non lymphedema group. The amount and duration of seroma drainage was not a risk factor for lymphedema. However on comparing drainage less than 10 days and more than 10 days in lymphedema group the P value is 0.05 indicating if the duration of seroma drainage is more than 10 days it can be a risk factor however more number of cases are required to prove a strong correlation.

40% of the patients did not receive radiotherapy as it was not indicated. 44% received radiation to chest and supraclavicular area. This included the patients who received radiation to chestwall exclusively. Only 14% of advanced cases received radiation to axilla along with chest wall and supraclavicular area. Among the lymphedema group, there was a rising trend towards arm edema on increasing the radiated area. More sample size was required to prove statistical significance.

Weight gain after surgery of adjuvant therapy was considered as a risk factor for lymphedema [(2)]. However, only one patient had weight gain and developed lymphedema. Most of the women in fact lose weight during the course of therapy in our setup. Weight gain was observed in only 10% of the patients.

The advantage of this study is it encompasses many risk factors which have been proposed in various studies. The assessment of swelling was done by single observer thus error was reduced. It was a prospective study and patients were on regular follow up.

The disadvantage is more sample was required. Also there may be patients who develop arm edema after one year thus long term follow up would be required.

Conclusion

CONCLUSIONS

The incidence of lymphedema according to our institute was 25.24%.

The risk factors which was statistically significant were anthracycline based chemotherapy and post radiotherapy skin involvement.

Estrogen receptor status had indirect correlation with lymphedema as it decides the chemotherapy regimen.

Seroma drainage for more than 10 days was also proved to be significant factor statistically.

There was a rising trend towards radiation to axilla and lymphedema however statistic significance was not conclusive.

Factors like age, BMI, hypertension, comorbid condition, upper limb morbidity, side of the disease, histopathology, lymphnode status, stage of the disease, type of surgery, radiation and weight gain were not proven as risk factor statistically. More number of patients and longer duration of study were required to prove further correlation and significance of factors.

It is important to consider the ethnicity and cultural habits of the patients while stratifying the risk as it is a lifestyle disease.

Lymphedema is a preventable condition and preoperative lymphedema education can help immensely in reducing the incidence as there are ambiguities narrowing the risks in each individual.

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Annexures

CONSENT FORM FOR PATICIPATION IN THE STUDY

Arm lymphedema is a common problem seen in patients following surgery for breast cancer. It is a debilitating condition which is associated with certain risk factors. This study is about finding out the incidence of lymphedema among patients after breast cancer surgery. We will also study some parameters like weight, infection etc which may be responsible for the development of lymphedema and the attributable risk factors.

The patient will be assessed preoperatively with weight and height and limb measurement . Measurement of the limb will be done with a measuring tape and bioimpedance analyser to look for fat content and water content of the limb and body. The patient will be monitored after surgery for the amount of collection in the drain, wound infection, type of cancer of the breast. She will undergo usual treatment of breast cancer like surgery, chemotherapy and radiotherapy. She will have to follow up regularly at 1 month, 3 months, 6 months and 1 year after surgery for measurement . If she feels any tightness of the arm or heaviness she will have to contact immediately.

The duration of study is 1 year.

There are no risks or discomfort or benefits involved in participating in the study.

The patients information and identity will be kept confidential and will be accessed only to the investigators.

Participation in the study is totally voluntary and patient can withdraw any time she wishes to do so.

There will be no compensation paid in view of any complications during the treatment.

If there is any significant finding during the study, the patient will be informed about further course of treatment or intervention required.

Approximate number of participants in the study: 100 women.

Understanding the above facts, I give my consent to participate in the study.

Name of the participant:

Sign

Date

Place :

Name and sign of witness

Name and sign of person taking the consent:

Proforma

1. Name
2. Age <40 yrs, 40-60 yrs, >60 yrs
3. Occupation
4. Hospital number
5. Weight
6. Height
7. Body mass index <25, 25-30, 30-35, >35
8. History of injury to the upper limb previously: yes/ no
9. Hypertension yes/ no
10. Comorbid condition
11. Family history of breast cancer Y/N
12. Arthritis Y/N
13. History of lymphedema in family Y/N
14. History of lymphedema in family member affected with carcinoma breast y/n
15. Medications causing fluid retention? Y/N
16. Education level: < highschool, college graduate, post graduate, professional
17. Marital status: married, divorced, widow, unmarried, never married
18. Socioeconomic status: poor/ middle/ upper class
19. Side: left/right/ bilateral
20. Stage of the disease:
21. Metastasis present: Y/N
22. Shoulder pain or difficult mobility preoperatively: Y/N
23. Upper limb deformity on the affected side Y/N
24. Range of movements of shoulder joint normal/ abnormal
25. Date of surgery
26. Level of axillary dissection
27. Type of tumour (histology)
28. Grade of tumour : well, moderately, poorly differentiated

29. Number of nodes in the specimen identified
30. Number of nodes in the specimen involved.
31. Er/pr status: positive/ negative
32. Seroma: main wound: yes/no
33. Seroma: axilla: yes/no if yes then is it < 10ml or >10ml?
34. Wound infection:
    - Skin
    - Skin and subcutaneous tissue
    - Seroma infection
    - Lymphangitis

36 Total drain output: (all drains under flap and in axilla plus seroma aspiration
< 500
500-1000
1000-2000
>2000

37 Date/ day of drain removal and seroma stoppage
5-10 days,
10-15 days,
15-30 days
>30 days

38 Preop chemotherapy yes/ no

39 Post op chemotherapy: how many cycles?

40 Drugs given:

41 Anthracycline based chemo yes/ no

42 Radiotherapy: Dosage :

- Nil
- Chest wall
- Chest wall + supraclavicular field
- Chest wall + supraclavicular field+ full axilla

43 Weight gain during or after treatment : y/n

44 Measurement

Limb girth	Pre op	1 month	3 months	6 months	1 year
Arm 5cm					
Arm 10cm					
Arm 15					
Arm 29					
Forearm 5					
Forearm 10					
Forearm 15					
Forearm 20					
Wrist					
Index finger					

Master chart Code Book

Age	1. <40 2. 40-60 3. > 60
Upper limb abnormality	1. Yes 2 No
Comorbid condition	1. Yes 2 No
Hypertension	1. Yes 2 No
Medication	1. Yes 2 No
Marital status	1. Married
Socioeconomic status	1. Poor 2. Middle 3. Upper
Side of the disease	1. Left 2. Right 3. Bilateral
Surgery	1. MRM 2 BCS
Histoplathology (HPE)	1. invasive ductal 2. invasive ductal +tuberculcosis 3. invasive lobular 4. ductal carcinoma in situ
Stage of the disease	1. Stage I 2. Stage II 3. Stage III 4 . Stage IV 5. Tx
ER/PR status	1. Positive 2. Negative
Wound Complication	1. Yes 2 No
Duration of seroma drainage	1. 5-10days 2. 10-15days 3. 15-30days 4. >30days
Amount of seroma drainage (ml)	1. <500 2. 500-1000 3. 1000-2000 4. >2000
Chemotherapy	1. Nil 2. anthracycline only 3. anthracycline +taxane 4. taxane 5. taxane+ 2nd line chemo 6. Not Known
Radiotherapy	1. Nil

	2. chest wall 3. chest wall +supraclaviclular area 4. chest wall +supraclaviclular area+ axilla
Skin	1. no reaction 2. reaction 3. necrosis 4. Not applicable
Lymphedema	1. yes 2. no
Weight gain	1. yes 2. no

sno	NAME	HOSP. NO.	AGE	WEIGHT	HEIGHT	BMI	UPPER LIMB ABNORMALITY	COMORBID	HYPERTENSION	MEDICATION	MARITAL STATUS	SOCIOECONOMIC STATUS	SIDE	SURGERY	HPE	STAGE	NODES REMOVED	NODES INVOLVED	ER/PR	WOUND COMPLICATION	DURATION OF DRAINAGE	SEROMA COLLECTION	CHEMO	RADIO THERAPY	SKIN INVOLVEMENT	LYMPH EDEMA	WT. GAIN
1	akidan khatoon	115841f	2	65	152	28.1	2	2	2	2	1	1	1	1	1	4	3	2	1	1	3	2	3	1	4	2	2
2	amina khatoon	209081f	2	77	165	28.3	2	2	2	2	1	2	2	1	1	5	28	0	1	2	2	4	3	3	1	2	2
3	anjala	117656f	2	75	149	33.8	2	2	2	2	1	2	2	2	1	3	11	2	1	2	1	1	3	1	4	2	2
4	anju bibi	167530f	1	52	150	23.1	2	2	2	2	1	1	2	1	1	1	5	0	2	2	3	1	3	1	4	2	2
5	arti das	19194f	2	50	150	22.2	2	1	2	2	1	2	1	1	1	4	9	7	1	2	4	2	3	4	1	2	2
6	baby saha	243219f	1	65	150	28.9	2	2	2	2	1	2	2	1	1	1	11	2	1	1	1	1	3	3	1	2	2
7	bahnumathy	171441f	2	59	144	28.4	2	1	1	2	1	2	2	1	1	4	10	0	2	2	1	1	3	1	4	2	2
8	banu	114220f	2	44	143	21.5	1	2	2	1	1	2	2	1	1	2	7	0	1	2	3	2	2	1	4	2	1
9	bhavani	746733c	2	48	150	21.3	2	1	2	2	1	2	1	1	1	1	11	0	1	2	2	2	2	1	4	2	2
10	bimal sinha	153842f	2	89	158	35.7	2	1	1	1	1	2	1	1	1	2	15	3	2	1	2	3	3	3	2	2	2
11	bimala jana	108652f	2	34	139	17.6	2	2	2	2	1	2	1	1	1	2	16	1	2	2	1	1	1	2	1	2	2
12	chandrika devi	113857f	1	60	152	25.9	2	2	2	2	1	2	1	1	1	2	15	0	1	2	1	1	2	2	1	2	2
13	devaki	124100c	2	73	154	30.4	2	1	2	2	1	2	1	1	1	4	18	0	2	2	2	2	3	1	4	1	2
14	dulsie	069389f	2	79	159	31.2	1	2	2	2	1	2	2	1	1	5	13	10	1	2	1	1	3	3	2	2	1
15	elsamma	235916f	2	65	150	28.8	2	2	2	2	1	2	1	2	1	1	14	0	2	1	1	1	3	1	4	2	2
16	geeta	065307f	2	73	153	31.2	2	2	2	2	1	2	2	1	1	4	19	0	1	2	1	2	2	3	2	2	2
17	geetanjali	127537f	1	35	143	17.1	2	2	2	2	1	2	2	1	2	4	0	0	2	1	1	1	3	4	2	1	2
18	grace nirmala	167699f	2	81	147	37.5	2	2	2	2	1	2	2	1	1	2	14	0	1	2	2	2	3	1	4	2	2
19	gracy	486104c	3	70	152	30.3	1	1	1	1	1	2	1	1	1	1	11	0	1	2	1	2	1	1	4	2	2
20	guddi singh	172644f	1	48	153	20.5	2	1	2	2	1	2	1	1	1	4	13	0	NA	2	1	1	3	3	1	2	2
21	hafisa	670732b	1	61	167	21.9	2	2	2	2	1	2	1	1	1	3	19	4	1	2	3	3	3	4	2	2	1
22	hilda SR	164439f	2	64	161	24.1	2	1	2	2	1	2	B	1	1	3	15	0	1	2	2	3	3	3	2	1	2
23	himambee	1439998f	1	60	150	26.7	2	2	2	2	1	2	1	1	1	4	14	9	2	2	2	1	5	3	2	1	2
24	isha bee	502592	2	58	148	26.5	2	1	1	2	1	2	1	1	1	3	14	0	2	1	4	4	4	3	2	2	2
25	jalaseeshu kumari	155524f	2	25	155	27.5	2	2	2	2	1	2	B	1	1	4	6	3	2	2	4	4	3	3	1	2	1
26	jyotsna saw	183754f	2	48	150	21.3	2	2	2	2	1	1	1	1	1	4	9	6	2	2	4	2	2	1	4	2	2
27	kabita sen	148571f	2	73	155	30.4	2	1	1	1	1	2	1	1	1	4	7	2	1	2	3	3	1	3	1	2	2
28	kamalam	125132f	2	52	154	21.9	2	2	1	2	1	1	2	1	1	2	17	2	1	2	2	1	3	1	4	2	2
29	kanchan moni	134735f	2	80	141	40.2	2	2	2	2	1	2	2	1	1	2	13	1	1	1	1	1	1	2	1	2	2
30	kasturi	176717f	2	67	151	29.7	1	1	1	2	1	2	2	1	1	4	10	2	2	1	1	1	3	3	1	2	2
31	kavikarasi	230653f	3	64	145	30.4	2	2	1	2	1	2	2	1	1	1	14	14	1	1	3	2	2	1	4	2	2
32	lalawati devi	125528f	1	35	145	17.5	2	2	2	2	1	2	B	1	1	4	10	2	1	1	2	1	3	3	1	2	2
33	laxmi d	226771f	1	54	154	22.8	2	2	2	2	1	2	1	1	1	5	10	0	2	2	1	1	1	1	4	2	2
34	laxmi devi	116399f	2	48	141	24.4	2	2	2	2	1	1	2	1	1	4	16	0	2	1	2	1	2	3	3	2	2
35	laxmirani paul	193313f	3	60	148	27.4	1	2	2	2	1	2	2	1	1	2	14	1	1	2	2	2	6	1	4	2	2
36	madhanlane	176276f	2	82	152	35.5	2	2	2	2	1	2	1	1	1	4	9	1	2	1	3	4	3	1	4	1	2
37	malarkodi	087995f	2	48	148	21.9	2	1	1	2	1	1	1	1	1	3	8	0	2	2	1	1	3	3	1	1	2
38	mangalaxmi	181941f	2	57	151	25.9	2	1	2	2	1	2	2	1	1	2	19	0	1	2	3	2	1	1	4	2	2
39	manjula	093547f	2	60	160	23.4	2	2	2	2	1	1	1	1	1	5	15	1	2	2	1	1	3	4	1	1	2
40	margatham	153714f	2	55	150	24.4	1	2	2	2	1	2	2	1	1	5	25	6	1	2	2	2	3	4	2	1	2
41	mariyamma	186846f	3	74	147	34.2	2	2	1	2	1	2	1	1	1	5	11	11	2	1	3	4	2	1	4	1	2
42	mary kujur	238886f	2	62	149	27.9	2	2	2	2	1	2	2	2	1	2	7	2	1	2	2	1	3	4	2	2	2
43	meena	092279f	2	53	148	24.2	2	1	2	2	1	1	B	1	2	2	7	0	2	2	1	2	3	1	4	1	2
44	meena singh	979083d	2	76	156	31.2	2	2	2	2	1	2	2	1	3	3	16	16	1	2	4	4	3	1	4	2	2
45	meller baby	226029f	2	56	152	24.8	2	1	1	2	1	2	2	1	1	1	10	0	1	2	2	2	1	1	4	1	2
46	mercy	210754b	2	55	154	23.2	2	1	2	2	1	2	2	2	1	2	13	0	1	2	1	1	2	3	1	2	2
47	minnala devi	033426c	2	54	150	24	2	1	2	2	1	1	1	1	1	2	17	0	1	2	3	1	2	2	1	2	2
48	minu barikh	181686f	2	49	150	21.7	2	2	2	2	1	2	1	1	1	4	5	5	1	2	2	1	2	3	1	2	2
49	mita palit	225023f	2	64	156	26.3	2	2	1	2	1	2	B	1	1	1	13	1	1	2	1	2	3	2	1	2	2
50	nalini mary	995074c	2	63	145	29.9	2	2	2	2	1	2	2	1	4	3	21	0	2	2	2	2	2	3	1	2	2
51	namita saha	153494f	2	50	140	25.5	2	1	2	2	1	2	1	1	1	2	12	0	2	1	1	1	2	1	4	2	2
52	neelam	193821f	1	55	144	26.5	2	1	2	1	1	2	1	1	1	4	8	0	2	2	1	1	3	4	1	2	1
53	nimbal	923703d	2	56	144	26.6	1	1	1	2	1	2	1	1	1	3	13	0	2	2	2	1	3	3	1	2	2
54	padmini	351427d	2	65	155	27.1	2	1	2	2	1	2	1	1	1	3	16	0	2	1	2	2	4	3	3	1	2
55	parimala	447930c	2	66	163	24.8	2	2	2	2	1	2	2	1	1	4	9	1	1	2	2	1	3	3	1	2	2
56	parul das	224019f	2	52	144	25	1	2	1	2	1	2	1	1	1	2	24	0	2	2	2	2	3	1	4	2	2
57	philo francis	195844f	2	55	139	28.5	2	2	2	2	1	2	1	1	1	2	18	6	1	2	3	1	3	4	2	2	2
58	poly chopra	104100f	1	68	152	29.4	2	2	2	2	1	2	2	1	1	4	7	0	2	1	2	1	3	3	1	1	1
59	prabhavati devi	047680f	2	60	145	28.1	2	1	1	1	1	2	1	1	2	2	20	17	1	2	3	2	1	3	1	2	2
60	prema	205877f	3	65	157	23.3	2	1	2	1	1	2	2	1	1	4	16	8	1	2	4	4	3	3	2	2	2
61	promila saha	192579f	2	60	144	28.9	1	2	2	2	1	2	2	1	1	5	21	2	1	1	2	1	3	3	2	2	2
62	radha	125212f	3	54	145	25.7	2	2	2	2	1	2	1	1	1	4	9	0	1	2	1	2	2	1	4	2	2
63	rajeshwari	368594a	3	62	155	25.8	2	2	1	2	1	2	2	1	4	1	23	0	1	2	2	2	1	1	4	2	2
64	rajeshwari R	142639f	2	56	145	26.6	2	2	2	2	1	2	1	1	1	5	16	0	2	2	2	1	3	3	1	2	1
65	ramadevi	233341f	2	66	160	25.8	1	1	1	2	1	3	2	1	1	1	7	2	1	2	4	4	3	4	2	2	2
66	ratna sarcar	186521f	2	65	154	27.4	2	2	2	2	1	2	2	1	1	3	10	0	2	1	3	3	3	1	4	2	2
67	renuga	192113f	2	65	151	28.5	2	1	1	2	1	2	1	1	1	3	19	0	2	2	2	2	3	1	4	1	2
68	sabita S	030494f	1	49	156	20.9	2	2	2	2	1	2	1	1	1	4	8	0	1	2	1	1	3	3	1	2	2
69	sandhya majumda	232278f	3	71	153	30.3	2	2	1	2	1	2	2	1	1	4	23	9	1	2	3	3	1	1	4	2	2

70	santu nath	149857f	2	68	157	27.6	1	2	2	2	1	2	2	1	1	4	10	2	1	2	1	2	3	4	1	2	1
71	saroja	176457f	2	81	147	37.5	2	2	2	2	1	2	2	1	1	2	13	0	1	1	4	3	2	1	4	2	2
72	sayba bairagi	221590f	2	43	138	22.6	2	2	2	2	1	2	2	1	1	2	12	0	1	2	2	1	2	1	4	2	2
73	selvi	900987d	2	54	150	24	2	2	1	2	1	1	1	1	1	3	7	7	2	1	3	2	3	3	1	2	2
74	shantakumari	145517f	2	56	155	23.5	2	2	2	2	1	2	2	1	1	3	19	0	2	2	3	3	2	4	1	2	1
75	shanti P	125264f	1	70	147	32.4	2	2	2	2	1	2	2	1	1	3	5	0	1	2	4	3	3	3	1	1	2
76	shantikumari	138679f	1	67	147	33.2	2	2	2	2	1	2	2	1	1	3	20	0	2	2	2	2	4	1	1	2	2
77	shashi mishra	131207f	3	62	157	25.2	2	1	2	2	1	2	2	1	1	5	13	1	1	2	1	1	2	3	1	2	2
78	shibani biswas	106810f	2	62	152	26.8	1	1	2	2	1	2	B	1	1	3	7	4	1	1	4	2	3	4	2	2	2
79	shibani ghosh	239901f	2	63	152	27.3	2	2	2	2	1	2	1	1	2	2	15	3	2	2	1	1	3	3	1	2	2
80	srilaxmi	150744f	2	49	152	20.8	2	1	1	2	1	2	2	1	1	4	20	1	2	2	3	3	3	3	1	2	2
81	sunderammal	321514c	3	59	148	26.9	2	2	2	2	1	2	1	1	1	3	17	7	2	2	3	2	3	3	2	1	2
82	sushila	393046c	2	77	158	30.8	2	2	2	2	1	2	2	1	1	2	17	0	1	2	2	2	2	1	4	2	2
83	vijayaprabha	129795f	2	70	152	30.3	1	2	2	2	1	2	2	1	4	2	17	0	2	2	4	3	3	3	2	2	2
84	yasoda	224881f	3	90	163	33.8	2	1	2	2	1	1	1	1	1	1	13	0	1	1	3	3	2	1	4	2	2
85	parul rani	090792f	2	50	150	25	2	2	2	2	1	2	1	1	1	5	15	0	2	2	1	1	1	1	1	2	2
86	phulmaya	086846f	2	52	143	25.4	2	2	1	2	1	2	2	1	1	4	15	10	1	2	1	2	3	1	1	2	2
87	bijoylakshmi	181018f	2	40	147	18.5	2	2	2	2	1	2	2	1	3	2	2	0	2	1	1	1	2	1	4	2	2
88	hasina khan	975366c	2	62	158	24.8	1	1	2	2	1	2	2	1	1	1	23	0	2	2	4	4	3	1	4	1	2
89	biva ghosh	150071f	2	49	150	21.8	2	1	2	2	1	2	2	1	1	4	2	0	2	2	3	1	2		4	1	2
90	madhabi pal	268958f	2	55	156	22.6	1	2	2	2	1	2	2	1	1	3	18	8	1	2	4	4	3	4	2	1	2
91	manju sadhukhan	216765f	2	46	150	20	2	2	2	2	1	1	2	1	1	3	18	3	2	2	2	1	3	1	4	2	2
92	kanammal	960351b	2	68	148	31	2	2	2	2	1	1	2	1	1	2	17	1	2	2	2	1	3	3	2	1	2
93	karthika	178494f	1	65	148	30	2	2	2	2	1	2	2	1	1	3	13	0	2	2	3	2	3	2	1	2	2
94	jasmin	233260f	2	86	160	33.6	2	1	1	2	1	2	2	1	1	2	6	3	2	2	4	4	3	4	2	1	2
95	rama das	137462f	2	50	150	22.2	2	2	2	2	1	2	1	1	1	4	12	5	1	1	2	1	3	4	2	1	2
96	priya barnwal	224111f	1	66	150	29.3	2	2	2	2	1	2	1	1	1	4	6	3	1	1	3	3	3	3	1	1	2
97	sunaina giri	342428c	2	75	150	33.3	2	1	1	2	1	2	2	2	1	2	4	0	1	2	NIL	NIL	2	2	2	2	2
98	sunaina sahani	093006f	2	70	155	29.1	1	2	2	2	1	2	1	1	1	4	8	1	1	2	4	2	3	3	2	1	2
99	susama bose	243989f	2	51	144	24.6	2	2	2	2	1	2	1	1	1	4	21	2	1	1	2	3	3	4	2	1	2
100	anjana ray	253790f	1	40	153	17	1	2	2	2	1	2	1	1	1	4	12	10	2	1	1	2	3	1	4	2	2
101	umarani	330221f	2	74	155	30.8	1	2	2	2	1	1	1	1	1	2	14	0	1	1	2	3	3	1	4	1	2
102	selvi k	085009d	2	50	147	23	2	2	2	2	1	2	1	1	1	4	16	0	2	2	2	2	3	1	4	2	2
103	preeti	277009f	1	57	154	24	2	2	2	2	1	2	1	1	1	4	12	2	2	2	1	1	3	3	2	2	1